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Notes on Some Bird Fleas, with the Description of a New Species of *Ceratophyllus*, and a Key to the Bird Fleas Known from Canada (Siphonaptera: Ceratophyllidae)¹

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Introduction

All known bird fleas are believed to have been derived from species that originally infested mammals. Circumstances evidently have occurred whereby representatives of species that were ordinarily the parasites of mammals became associated with birds, and were successful in establishing themselves on these hosts. These circumstances must have included some provision for isolation whereby the newly transferred colonies of fleas were not given the opportunity of becoming reassociated with the original hosts, and also were not contaminated by subsequent introductions of others of their species. Thus they were able to become adapted to an existence on the bodies and in the nests of avian hosts. The adaptations were physical as well as physiological, many bird fleas exhibiting morphological characteristics which, though not yet properly understood, apparently bear some relationship to their specialized environment.

Transference of fleas from natural to unnatural hosts occurs frequently through host or habitat association. Usually, the unfortunate fleas, marooned on hosts that do not satisfy their physical or physiological needs, are doomed to die. Rare exceptions have resulted in successful establishment, and in the ultimate evolution of new species that may be unable to transfer back to the old environment, should the opportunity be presented.

According to the latest accounts (Freeman, 1950; Allan, 1950) 17, or one-third, of the 51 species of fleas recorded from the British Isles are true parasites of birds. The known fraction of bird fleas for the New World is much less; this may, in part, be a reflection of the very limited attention that has been given to them.

With the exception of *Actenopsylla suavis* Jord. and Roths. (which, like the Palaearctic *Ornithopsylla laetitiae* Roths., is a pulicid and is related to a group of genera and species associated with rabbits) all the endemic bird fleas (genera *Mioctenopsylla* Roths., *Dasysyllus* Bak., and *Ceratophyllus* Curt.) known from North America belong to the Ceratophyllinae, a subfamily otherwise characteristically associated with rodents, or the predators of rodents.

Actenopsylla suavis is known only from Coronado Island, Mexico. *Mioctenopsylla arctica* Roths., described from Novaya Zemlya and reported from Iceland and Alaska, is not yet known from Canada. Two species of *Dasysyllus* and ten of *Ceratophyllus* have so far been recorded from Canada (Holland, 1949a, 1949b).

In the restricted sense (Jordan, 1933) most of the species of *Ceratophyllus* are true bird-parasites; there are a few species that appear to be mammal fleas. Two of the species recorded from Canada may fall into the latter category, but the available evidence is inconclusive. Actually, *Ceratophyllus*, as now con-

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stituted, appears to be polyphyletic, and composed of a number of species groups not very closely related, but associated by the mutual possession of characteristics that may be adaptive, and independently acquired by a number of ancestral species. A full study of the question is beyond the scope of this paper.

In the present paper, a new species of *Ceratophyllus* is described, and another species, hitherto unknown from Canada, is recorded. In addition, notes of special interest are given for some of the species already known from this country.

***Dasypsyllus stejneri* (Jordan)**

(Figs. 1, 2)

Ceratophyllus stejneri Jordan, 1929, Nov. Zool. 35: 36-37; pl. 2, figs. 22, 23.

Dasypsyllus stejneri, Holland, 1949, Proc. Ent. Soc. B. C. 45: 12. Holland, 1949, Canada Dept. Agr. Tech. Bull. 70: 150.

The species is very rare in collections; only four specimens are known to the writer. The original specimens, one male and one female, were collected from Bering Island and Commander Island, Siberia; the hosts were not recorded. The writer (1949a) recorded a single male from Langara Island, Queen Charlotte Islands, collected from the dwarf hermit thrush, *Hylocichla guttata nanus* (Audubon), and (1949b) reported another male from St. Paul Island, Pribiloff Islands, Alaska, host unknown. These two specimens agree with the holotype male (U.S. Nat. Mus. type No. 41437), with which they were compared.

***Ceratophyllus vagabundus* (Boheman)**

(Figs. 3, 4)

Pulex vagabunda Boheman, 1866, Ofvers. Kongl. Vetensk. Akad. Förhandl. 22: 567; pl. 35, figs. 1, 1a.

Ceratophyllus vagabunda, Philip, 1938, J. Parasit. 24: 486.

Ceratophyllus vagabundus vagabundus, Jellison and Kohls, 1939, U.S. Pub. Hlth. Rept. 54: 2021. Jellison and Good, 1942, Nat. Inst. Hlth. Bull. 178: 38-39 (Bibliography of references).

The species was described from Spitzbergen; subspecies have been described from Great Britain, Switzerland, and Siberia. Philip (1938) and Jellison and Kohls (1939) recorded one male and two females of this species from a nest and fledglings of the golden eagle, *Aquila chrysaetos* [*A. chrysaetos canadensis* (Linn.)]; this was the first North American record of this circumpolar species. The specimens were determined as of the nominate race by Dr. Karl Jordan of the Zoological Museum, Tring, England.

In the Canadian National Collection there is a large series of fleas of this species from Kidluit Bay, Richards Island, Northwest Territories, 25.VII.48, collected from nests of the glaucous gull, *Larus hyperboreus* Gunnerus, by J. R. Vockeroth. Specimens from this series were sent to Mr. G. H. E. Hopkins at Tring, who was unable to distinguish them from topotypical specimens of *vagabundus*.

***Ceratophyllus lari* new species**

(Figs. 5, 7, and 9)

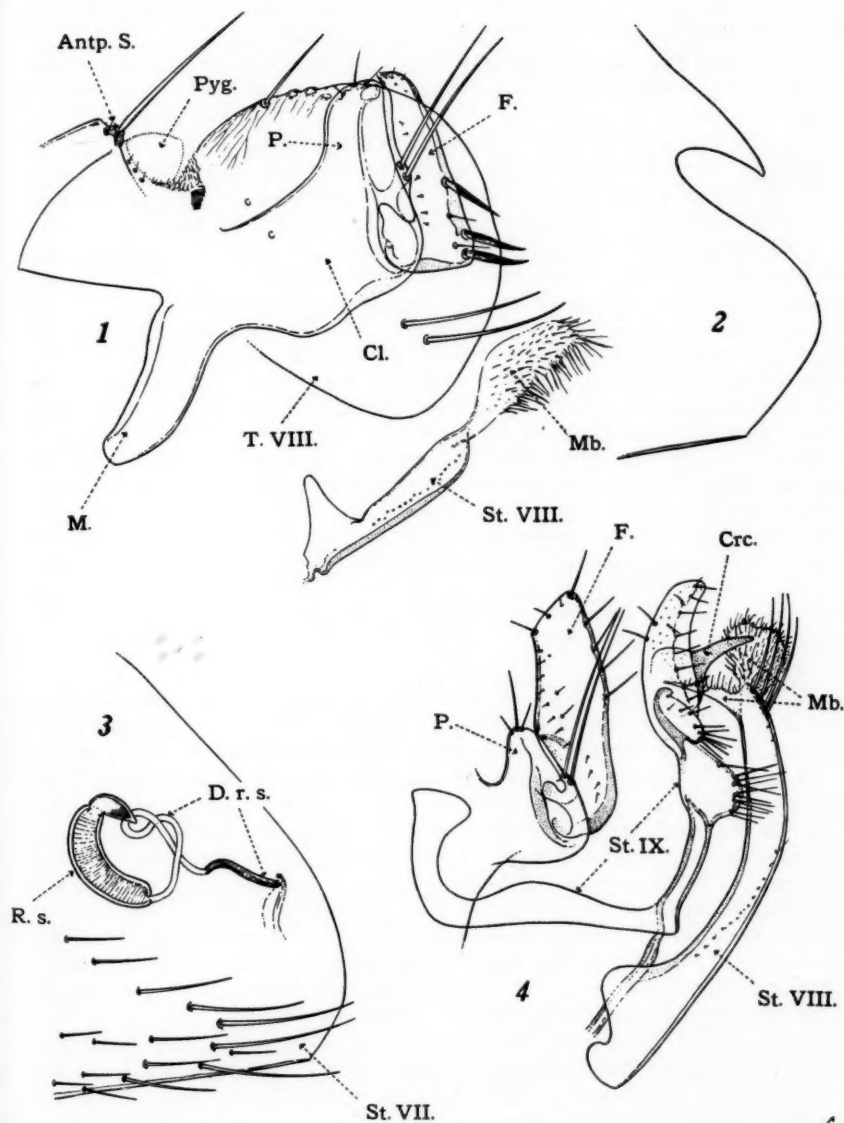
Nearest *Ceratophyllus niger* Fox, from which it is most easily separated in both sexes by having a large clypeal tubercle (Figs. 5 and 6).

Male

General structure and chaetotaxy very much as in *C. niger*. Head (Fig. 5) with ocular row of three long setae, and frontal row of about five or six thinner,

Abbreviations Used in Illustrations

Antp.S., antepygidial setae; Cl., clasper; Clp.T., clypeal tubercle; Crc., crochet ("paramere" of authors); D.r.s., ductus receptaculi seminis; F., movable process of clasper; Gl.W., gland of Wagner; M., manubrium; Mb., membranous appendage of sternum VIII; P. immovable process of clasper; R.s., spermatheca, or receptaculum seminis; Pyg., sensillum ("pygidium" of authors); Spr., spiracle; St., abdominal sternum; T., abdominal tergum.



FIGS. 1-4

Fig. 1. *Dasypsyllus stejnegeri* (Jordan). Male genitalia (specimen from Langara Island, Queen Charlotte Islands, B.C.). Fig. 2. *D. stejnegeri*. Sternum VII of female (after Jordan). Fig. 3. *Ceratophyllus v. vagabundus* (Boheman). Sternum VII and spermatheca of female (Kidluit Bay, N.W.T.). Fig. 4. *C. v. vagabundus*. Genitalia of male.

shorter setae. Clypeal tubercle very conspicuous. Eye large and deeply pigmented. Second antennal segment with marginal bristles exceeding half the length of the club, as is usual in this and related genera.

Pronotum with about 12-14 long, heavy spines per side. Mesonotum with a few slender pseudosetae. Collar of metanotum reduced, with apical spinelets weak or lacking.

Abdominal spiracles I-VII much larger than those of *C. niger*, all of them with the atrial chamber appearing doubled up (in most specimens of *C. niger* only the first two pairs are like this). Apical spinelets on abdominal terga as follows: I, 2 (rarely 1) per side; II, 2; III, 2; IV, 1 (sometimes 2).

Modified abdominal segments of same general appearance as those of *niger*, but differing in details. Immovable process P somewhat longer, and movable process F with the angle on the anterior margin somewhat more dorsad (Fig. 7). Process F with long marginal setae as shown. Crochet of aedeagus broader and more bluntly pointed than in *C. niger*. Tergum VIII with a row of about 12 long, strong setae, the first 8 or 9 of which are inserted along the dorsal margin, and the remainder of which are inserted laterally on the sclerite, as the row curves ventrally. An extensive spiculate area on the dorsal inner surface of tergum VIII. Sternum VIII long and rod-like, with nearly parallel margins. Apically, about three strong, curved setae on either side. A small, finger-like membranous appendage arising dorsally from each side of the apex of sternum VIII; this appendage somewhat variable in size, but seldom attaining half the length of the corresponding structure in *C. niger* (Figs. 7 and 8); usually much smaller. Penis rods and apodemal rod of sternum IX coiled up, completing more than one full convolution. One long antepygial seta, with a minute hair on either side at the base.

Female

Chaetotaxy of head as in the male, but frontal row of setae somewhat weaker, sometimes with only three slender bristles. Antennae with usual sexual differences; setae of segment II attaining or exceeding the length of the club.

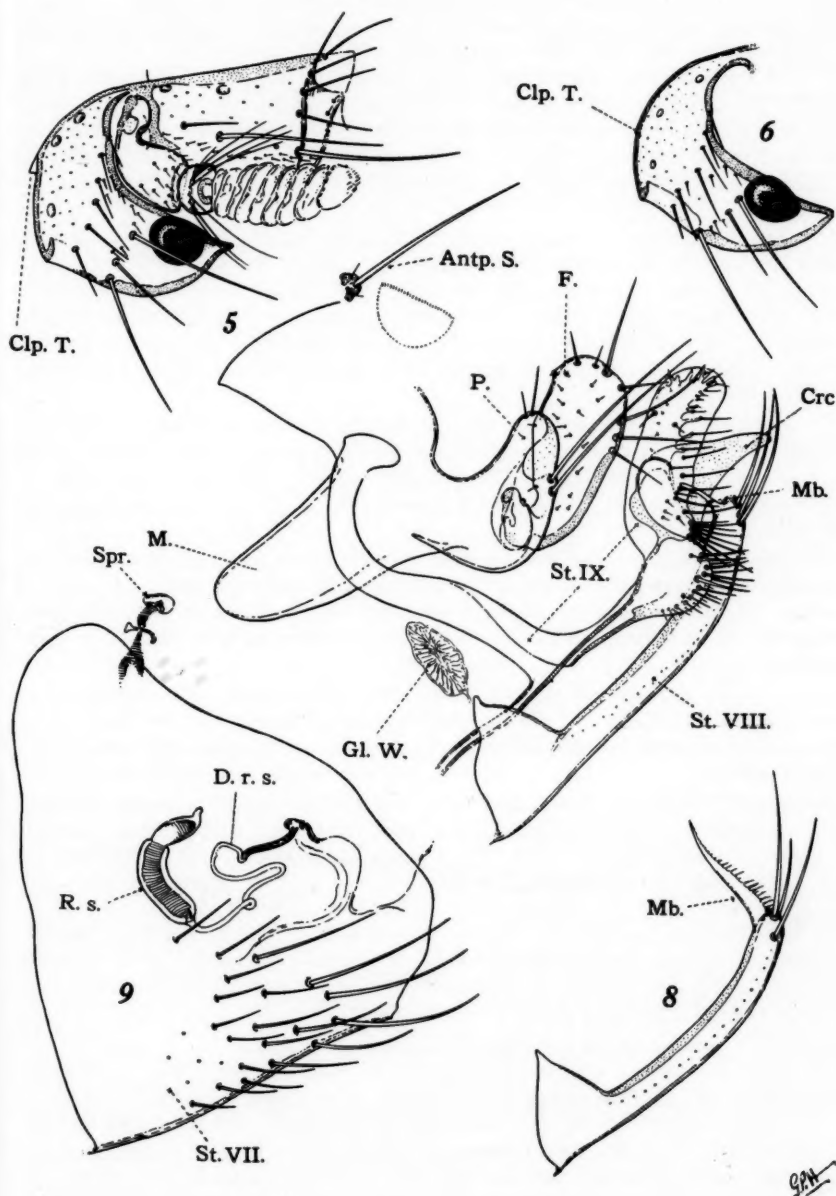
The large spiracular openings on the abdomen particularly noticeable. Three well-developed antepygial setae on either side; the dorsal seta about two-fifths as long as the middle seta, the ventral seta about one-third. The spermatheca, or receptaculum seminis, of the narrow type, with the tail or appendage almost as broad as the head or body (Fig. 9). Head of spermatheca sausage-shaped, parallel-sided, and with conspicuous internal ring-like thickenings. Basal part of duct of spermatheca sclerotized. Sternum VII bearing somewhat more setae than are usually found in *C. niger*, and the posterior margin entire in all available specimens, except in a number where the margin is broken away, this damage presumably having occurred during the mating act.

Holotype, ♂, Whaleback Island, Great Slave Lake, Northwest Territories, June 23, 1947, collected from the nests of gulls (either *Larus californicus* Lawrence or *L. argentatus smithsonianus* Coues), by J. R. Vockeroth; No. 5952 in the Canadian National Collection, Ottawa.

Allotype, ♀, same data.

Paratypes, 24 ♂, 49 ♀ on slides, and many more in alcohol; same data.

Paratypes have been sent to the Zoological Museum, Tring, England; the United States National Museum, Washington, D.C.; the Rocky Mountain Laboratory, Hamilton, Montana; the Plague Suppressive Measures Laboratory, San Francisco, California; the Museum of Comparative Zoology, Cambridge, Massachusetts; and the collection of Major Robert Traub, Washington, D.C.



FIGS. 5-9

Fig. 5. *C-ratophyllus lari*, n. sp. Head (holotype). Fig. 6. *Ceratophyllus niger* Fox. Preantennal region of head of male (Victoria, B.C.). Fig. 7. *C. lari*. Genitalia of male (holotype). Fig. 8. *C. niger*. Sternum VIII of male. Fig. 9. *C. lari*. Sternum VII and spermatheca of female (allotype).

Ceratophyllus lunatus tundrensis Holland, new status

Ceratophyllus tundrensis Holland, 1944, Can. Ent. 76: 242-244; pl. 17, figs. 1-3. Holland, 1949, Canada Dept. Agr. Tech. Bull. 70: 150; pl. 33, figs. 261, 262; map 33.

The writer (1949) mentioned that *C. tundrensis* was very close to the Palaearctic species *C. lunatus* Jord. and Roths., and suggested that probably it should be considered a Nearctic subspecies of the latter. The types and other specimens of *lunatus* and *tundrensis* have now been compared; this study revealed that the two forms, though separable, are indeed very much alike, and should be considered subspecies.

The dorsal spiculate area of tergum VIII in the male of *C. l. lunatus* is greater than that of *C. l. tundrensis*. In *lunatus* the breadth of the process P at the level of the lower acetabular seta is approximately equal to the breadth of the narrowest part of the longitudinal portion of the clasper; in *tundrensis* the former exceeds the latter. The three long setae on the posterior margin of the movable process F are about equally spaced in *lunatus*; the lower two are closer together in *tundrensis*.

Mid- and hind-tibiae in both sexes of *tundrensis* with two (sometimes three) dorsal bristles between the postmedian and subapical pairs, stouter than the lateral bristles; usually a minute additional dorsal bristle. Mid- and hind-tibiae of *lunatus* with one stout bristle, and a minute one, or two minute ones, and no stoutish bristles.

The species is not well known from the Palaearctic or Nearctic regions, and no specimens have been collected from birds. Records and specimens of *C. l. lunatus* available to the writer have all been from weasels or alpine rodents. Similarly, all material known of *C. l. tundrensis* is from weasels, marten, or small rodents.

C. l. tundrensis appears to have a truly arctic distribution. The original series was from Baker Lake and Clinton Colden Lake, Northwest Territories, the recorded hosts being weasels and marten. The following additional material has been examined.

Northwest Territories: Reindeer Depot, 6.VIII.48, ex *Clethrionomys dawsoni* (Merriam), 1 ♀ (J. R. Vockeroth); Contwayto Lake, 10.VIII.49, ex *Citellus parryi* (Richardson), 1 ♀ (A. W. F. Banfield); Baker Lake, 22.VII.47, ex *Dicrostonyx groenlandicus* (Traill), 1 ♂; 30.VII.47, ex *Mustela* sp., 1 ♂, 1 ♀ (T. N. Freeman); Eskimo Point, VIII.50, ex *Citellus parryi*, 1 ♀ (G. R. Roberts); Repulse Bay, 21.VIII.50, ex *Mustela* sp., 1 ♂ (J. E. Martin); QUEBEC: Belcher Islands, Hudson Bay, 23.V.38, ex "*Mustela cicognanii*" [= *M. erminea* Linn.], 1 ♂, 1 ♀ (A. C. Twomey); Great Whale River, 10.VIII.49, ex nest of *Dicrostonyx groenlandicus*, 1 ♀ (J. R. V.).

Ceratophyllus petrochelidoni Wagner

(Fig. 10)

Ceratophyllus petrochelidoni Wagner, 1936, Zeitsch. f. Parasitenk. 8: 655-656; text fig. 2. Holland, 1949, Canada Dept. Agr. Tech. Bull. 70: 149; pl. 32, figs. 256-258; map 32.

The species was described from a pair collected at Chilcotin (type locality), and a male from Kamloops, British Columbia, all from "*Petrochelidon lunifrons*" [*P. pyrrhonata albifrons* (Rafinesque)], which is apparently the true host. Specimens have since been collected in Montana and California, again from cliff swallows.

The apical margin of sternum VII of the single female (allotype) available to Wagner had a pronounced sinus. ("Der Apikalrand des 7. Sternits hat einen Seitensinus und läuft obenher wie ein unsymmetrisch gerundeter Lappen aus.")

The writer (1949) pointed out that sternum VII of females from Alameda Co., California, varied in this character, some having and others not having the sinus.

Large collections of *C. petrochelidoni* have since been made, from Tunkwa Lake and Quick, B.C., all from nests of *Petrochelidon p. albifrons*. Study of these reveals that sternum VII is polymorphic, and that the apical margin on each side varies continuously from deep incision to entirety. Fig. 10 illustrates nine examples of this variation, selected from a collection made at Tunkwa Lake. It will be noted that the most deeply incised individuals have the area adjacent to the margin of the sinus more heavily sclerotized than the remainder of the sternum.

The largest collections of this species were made in the autumn after the swallows had vacated their nests.

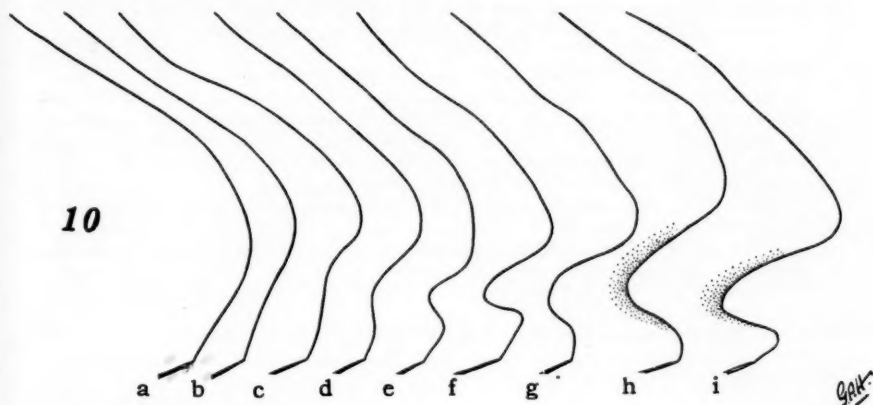


Fig. 10. *Ceratophyllus petrochelidoni* Wagner. Variation in the contour of sternum VII of female (a series from Tunkwa Lake, B.C.).

Key to the Bird Fleas Known from Canada

Note: This key includes *Ceratophyllus adustus* Jordan and *C. lunatus tundrensis* Holland, both of which may be fleas of mammals. However, it is not justifiable to exclude them at this time, for knowledge of their host preference is still indefinite.

Figure references in roman type pertain to illustrations in this paper; those in italics pertain to figures published in *The Siphonaptera of Canada* (Holland, 1949b).

In the key, the first mention of each species includes comments on distribution and preferred hosts.

1. Third pair of plantar bristles of tarsal segments V subventral (*Fig. 264*)—*Dasyptyllus* Baker 2
- All plantar bristles lateral—*Ceratophyllus* Curtis 5
2. Males 3
- Females 4
3. F squarish apically; angle spiniform long and twisted (*Fig. 265*). Sternum VIII vestigial. Many hosts, especially passerines; west of the Coast Range only *gallinulae perpinnatus* (Baker)
- F pointed apically; angle spiniform normal. Sternum VIII not vestigial (*Fig. 1*). Range and true hosts not known. One record, from Queen Charlotte Islands *stejnegeri* (Jordan)

4. Lobe of sternum VII broad and square (Fig. 266)..... *gallinulae perpinnatus* (Baker)
- Lobe of sternum VII sharply pointed (Fig. 2)..... *stejnegeri* (Jordan)
5. Fourth dorsal notch of hind tibia with single thin seta (Fig. 241). Male not known.
Recorded only from Atlin, B.C., from porcupine (accidental host?)..... *adustus* Jordan
- Fourth dorsal notch with two stout (normal) setae (Fig. 243)..... 6
6. Males 7
- Females 17
7. F widest in proximal half (Fig. 256). In Canada recorded only from British Columbia
from cliff swallows, which are the true hosts..... *petrochelidoni* Wagner
- F widest in distal half 8
8. P narrow, its posterior margin strongly concave (Fig. 244). Recorded only from
British Columbia. True hosts apparently bank swallows..... *celsus celsus* Jordan
- P broader, its posterior margin not, or only slightly, concave 9
9. Penis rods and apodemal rod of sternum IX not completing a full turn 10
- Penis rods and apodemal rod long, and completing at least one full turn 11
10. Sternum VIII broad, equalling width of F, and tapering apically, with stout, stiff setae
closely grouped at apex (Fig. 250). Holarctic, on ground-nesting birds.....
- garei* Rothschild
- Sternum VIII narrower than F; apical setae not closely grouped (Fig. 246). Wide-
spread, on many species of birds..... *diffinis* Jordan
11. Tergum VIII with a row of 20 or more marginal setae, extending around postero-
dorsal apex of sclerite. Holarctic, on bank swallows..... *riparius* Jordan & Rothschild
- Twelve or fewer marginal setae, not reaching posterior apex of tergum VIII 12
12. Length of F three times width, and greatly exceeding P 13
- Length of F less than three times width, or, if three times width, barely exceeding P 14
13. Apical lobe of posterior arm of sternum IX tapering distally (Fig. 4). Holarctic.
One Canadian record, from Mackenzie delta, on gulls..... *vagabundus vagabundus* (Boheman)
- Apical lobe slightly dilated distally, not tapering. Introduced. Eastern Canada, west
to Saskatchewan. "European hen flea"..... *gallinae* (Schrank)
14. F only slightly exceeding P 15
- F exceeding P by an amount approximately equalling its greatest width 16
15. Inner dorsal spiculate area of tergum VIII conspicuous; clasper lobe exceedingly
narrow (Fig. 261). A barren-land species, on weasels and rodents.....
- lunatus tundrensis* Holland
- Spiculate area restricted to margin; clasper lobe broad (Fig. 252). Widespread
across temperate Canada, usually on tree swallows, purple martins, or bluebirds
idius Jordan and Rothschild
16. Apical membrane of sternum VIII approximately as long as adjacent setae (Fig. 8).
British Columbia and Alberta, on many birds. "Western hen flea"..... *niger* Fox
- Apical membrane much shorter than setae (Fig. 7). Known only from Northwest
Territories, on gulls..... *lari* new species
17. Bursa copulatrix with basal part of duct of spermatheca not sclerotized; head of
spermatheca broader in the middle than at the ends 18
- Duct of spermatheca sclerotized (Fig. 9); head of spermatheca long and cylindrical 19
18. Tail of spermatheca almost as long as body. Sternum VII with distinct lobe and
broad, shallow sinus (Fig. 247)..... *diffinis* Jordan
- Tail of spermatheca distinctly shorter than head. Sternum VII virtually entire
(Fig. 251)..... *garei* Rothschild
19. Abdominal spiracular openings I-VII presenting a doubled-over appearance 20
- Only anterior few spiracles doubled-over; at least spiracles V-VII circular 22
20. At least three rows, or substantial parts of rows, of setae on each typical abdominal
tergum..... *lunatus tundrensis* Holland
- Only two well-developed rows, a distal one of long, and a proximal one of short,
setae on each tergum 21
21. Head of spermatheca approximately as long as sensillum (pygidium); tail half as long
as body (Fig. 9)..... *lari* new species
- Head of spermatheca distinctly longer than sensillum; tail less than half as long as
body (Fig. 3)..... *vagabundus vagabundus* (Boheman)
22. Head of spermatheca almost twice as broad as tail (Fig. 249)..... *gallinae* (Schrank)
- Head relatively narrow, only slightly broader than tail 23
23. Sternum VII with pronounced lobe and sinus 24
- Sternum VII with apical margin entire 27

24. Terga II and III normally each with 4 apical spinelets per side.....
riparius Jordan and Rothschild 25
 Terga II and III normally each with 2 spinelets.....
25. First and third antepygial setae very short, each less than one-quarter as long as the middle one. About six short setae on each dorso-lateral surface of tergum VIII.....
 emarginate form of *petrochelidoni* Wagner
 First and third antepygial setae each at least one-quarter as long as the middle one.
 Tergum VIII with nine or more short setae on each dorso-lateral surface..... 26
26. Anal sternum distinctly angulate ventrally; length of stylet about 3 times breadth.....
idius Jordan and Rothschild
 Anal sternum rounded, or only very slightly angulate ventrally. Length of stylet about twice breadth.....
 emarginate form of *niger* Fox
27. About 30 lateral and marginal setae on ventral part of tergum VIII.....
celsus celsus Jordan 28
 These setae fewer than 20 in number.....
28. First and third antepygial setae very short, each less than one-quarter as long as the middle one.....
 non-emarginate form of *petrochelidoni* Wagner
 First and third setae each more than one-quarter as long as the middle one.....
 non-emarginate form of *niger* Fox

Acknowledgments

The writer is indebted to Dr. Karl Jordan, F.R.S., of the Zoological Museum, Tring, England, for his comments on the differences between *Ceratophyllus l. lunatus* and *C. l. tundrensis*, and to Mr. G. H. E. Hopkins of the same institution for his opinion on the specimens of *Ceratophyllus v. vagabundus*.

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The Geographic Variation of *Dasyuris polata* (Duponchel) in North America (Lepidoptera: Geometridae)¹

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The arctic species *Dasyuris polata*, described by Duponchel (1830: 402; Pl. 199, Fig. 4) from northern Europe, has been known from America since early times. The species is notoriously variable; until recently, however, it has not been possible to assess the geographic components of its variation.

There are now, largely as a product of the Northern Insect Survey, excellent series of *D. polata* in the Canadian National Collection. Through the kindness of correspondents I have been able to supplement these series by borrowing material of certain non-Canadian forms, and it has become evident that *D. polata* has striking geographic variation in North America.

I have no direct information on the type of *D. polata*, but genitalia of specimens from Greenland, Labrador, Alaska, Colorado, and other American localities agree with one another and with the genitalia of the European population as figured by Nordström, Wahlgren, and Tullgren (1941). The North American forms should accordingly be considered conspecific with *polata*, if the current European identification is correct.

The American populations fall, on general facies, into three classes:—

1. Ground colour dark gray, with narrow and moderately conspicuous paler bands. Greenland to Yukon; Colorado.
2. Ground colour pale, silky, bluish-gray, with inconspicuous darker lines. Mackenzie Delta and neighbouring regions; Ellesmere Island.
3. Ground colour silvery white, with broad, contrasting, black or dark-gray bands. Bradore Bay, Quebec; Cold Bay, Alaska.

The typical subspecies, from Europe, agrees with Class 1. I recognize six well-defined American subspecies, and suspect the existence of two others, which I do not have adequate material to characterize. Descriptions of the American populations follow.

Dasyuris polata brullei (Lefebvre)

Fig. 1

Larentia brullei Lefebvre, 1836: 399, Pl. 10, Fig. 8.

Larentia fumidotata Walker, 1862: 1701.

This is a dark form, of somewhat larger average size than most of the continental subspecies. The pale bands of the fore wings are narrow and poorly defined, the pale areas here and in the fringes being dull and brownish, not contrasting sharply with the ground colour. The ground colour in most of the specimens has a brown cast, but this is probably due to age. Some of the few specimens that I have seen come from widely separated localities, but they do not suggest that the species varies geographically in Greenland.

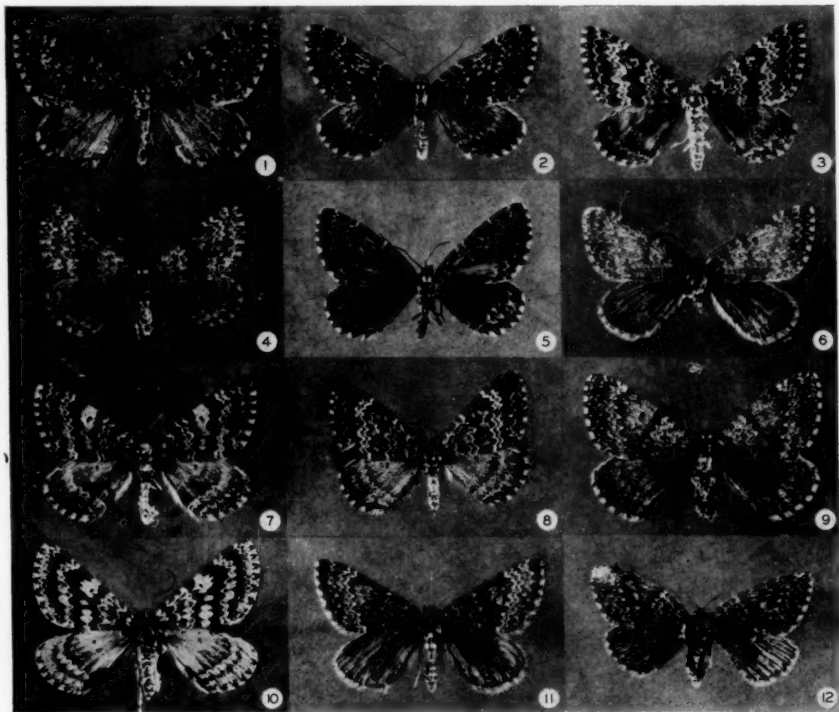
The type locality of *brullei* is given only as "pays des Esquimaux". Other species described in the same paper were from Labrador and from Greenland. The rather crude figure seems to agree with the Greenland subspecies better than with that of Labrador, and I accordingly follow the conventional identification. I am indebted to Mr. John L. Sperry for pointing out the synonymy of *Larentia fumidotata*; the name is omitted from McDunnough's list, to which it is in the strict sense extralimital. *Glaucopteryx immaculata* Skinner and Mengel (1892),

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from western Greenland, placed by McDunnough (1938) as a subspecies of *D. polata*, is described as having pectinate antennae, and cannot belong here; Dyar's (1902) reference of it to *Psychophora* is perhaps correct.

Material examined. Twelve specimens from Greenland, including specimens from the following localities: Thule; McCormick's Bay; Jameson Land.



Figs. 1-12

1. *Dasyuris polata brullei*, ♀. Greenland, Dr. Christ. U.S.N.M.
2. *Dasyuris polata punctipes*, ♂. Nain, Labrador, 24. VII. 1927. W. W. Perrett. C.N.C.
3. *Dasyuris polata punctipes*, ♂. Churchill, Man., 2. VIII. 1937, W. J. Brown. C.N.C.
4. *Dasyuris polata punctipes*, ♀. Chesterfield, N.W.T., 3. VIII. 1950, J. G. Chillcott. C.N.C.
5. *Dasyuris polata punctipes*, ♂, specimen resembling *D. p. ursata*. Chesterfield, N.W.T., 5. VIII. 1950, J. G. Chillcott. C.N.C.
6. *Dasyuris polata* ?subsp., ♂. Ellesmere Island, July, 1928, G. T. Mackinson. C.N.C.
7. *Dasyuris polata bradorata*, ♂, paratype. Bradore Bay, Que., 2. VIII. 1930, W. J. Brown. C.N.C.
8. *Dasyuris polata ursata*, ♂, paratype. Mile 24 W. of Dawson, Yukon, 3600 ft., 31. VII. 1949, P. F. Bruggemann. C.N.C.
9. *Dasyuris polata kidluitata*, ♀, paratype. Kidluit Bay, Richards Is., N.W.T., 26. VII. 1948, W. J. Brown. C.N.C.
10. *Dasyuris polata aleutiata*, ♀, allotype. Cold Bay, Alaska, July, 1942, B. H. Weber Coll., C.N.C.
11. *Dasyuris polata* ?subsp., ♂. "Col." U.S.N.M.
12. *Dasyuris polata* ?subsp., ♀. Grant, Park Co., Colo., VII. 24-26. 1922, 9000 ft. U.S.N.M.

***Dasyuris polata punctipes* (Curtis)**

Figs. 2-5

Melanydris punctipes Curtis, 1835: 73.

This widely distributed subspecies resembles *D. polata brullei* in the dark ground colour and in the poorly defined pale bands of the fore wings. The average size, however, is smaller; the pale bands of the fore wing are on the average broader; and all the pale markings of this wing are more nearly white, so that the pattern as a whole is more variegated. On the hind wing the post-medial bands are more evident than in *brullei*.

The subspecies is extremely variable individually, and also has some tendency to geographic variation, northern specimens tending to have the markings more blurred and confused than do southern ones (Churchill, Great Whale River, Hopedale). These geographic differences are, however, slight, and provide no basis for dividing the subspecies.

The type of *punctipes* presumably came from the Boothia Peninsula. I have not seen topotypical material, but there are in the Canadian National Collection specimens from either side of the type locality: from Repulse Bay, at the base of Melville Peninsula; and from Cambridge Bay, Victoria Island. The series from the two localities agree, and it is unlikely that they will prove to differ from the Boothia population. A short series from Chesterfield Inlet (Figs. 4, 5) is intermediate to the subspecies of the interior of the Northwest Territories; one specimen (Fig. 5) among seven would be referred on physical appearance to that subspecies. A few of the specimens from Hopedale, Labrador, are transitional to the subspecies described below from Bradore Bay, Que. A single specimen from Devon Island is too badly rubbed for identification.

Material examined. 279 specimens, from the following localities.

Labrador: Hopedale; Nain.

Quebec: Port Burwell; Fort Chimo; Wakeham Bay; Port Harrison; Great Whale River.

Nottingham Island, Hudson Strait.

Baffin Island: Lake Harbour; Amadjuak Bay; Frobisher Bay.

Southampton Island: Coral Harbour.

Manitoba: Churchill.

District of Keewatin: Eskimo Point; Chesterfield Inlet; Repulse Bay.

Victoria Island: Cambridge Bay.

***Dasyuris polata* (Duponchel), Ellesmere Island population**

Fig. 6

Two specimens in the Canadian National Collection from Ellesmere Island, taken in 1928 by G. T. Mackinson, differ from *D. polata punctipes* in having the ground colour pale and silvery gray, with the pale bands hardly evident. These specimens somewhat resemble those from Richards Island, described below, but differ in being smaller, and in having the dark transverse bands obscure. The Ellesmere Island population is probably a distinct subspecies, but this cannot be proved until more extensive material is available.

***Dasyuris polata bradorata*, new subspecies**

Fig. 7

A series from Bradore Bay, Que., differs from *D. polata punctipes* in the following respects. The pale bands are greatly extended and merge with the pallid ground colour, so that the remaining dark areas stand out as continuous or interrupted, contrasting, transverse bands. There are in the majority of specimens more or less extensive areas of bright rust-coloured scaling, especially

in the postmedial band, but also in the basal and sub-terminal areas. The specimen illustrated has unusually heavy and solid dark bands.

Some specimens from Hopedale, Labrador, of *D. polata punctipes* are transitional to this subspecies. No doubt a blend zone exists in southern Labrador.

Holotype, male; allotype, female; and 17 paratypes, all from Bradore Bay, Strait of Belle Isle, Que., taken on dates from July 30 to August 4, 1930, by W. J. Brown.

Type No. 5941, Canadian National Collection; one of the paratypes is in the collection of Mr. John L. Sperry, Riverside, Calif.

***Dasyuris polata ursata*, new subspecies**

Fig. 8

This resembles *D. polata polata* from northern Europe more closely than does any other American subspecies. As in that subspecies, the ground colour is dark and the pale transverse bands of the fore wing are narrow, contrasting, and definite. The wings in the present subspecies are, however, shorter and more rounded than in the two specimens of typical *polata* that I have examined; moreover, the ground colour of *ursata* differs from that of the specimens of *polata* and also from that shown in the European manuals. The European specimens seem normally, even when fresh, to have a brownish cast, whereas the ground colour of *ursata* lacks the brown tint, being very dark gray powdered more or less densely with pale gray. From the neighbouring subspecies *punctipes*, *ursata* can be distinguished by the narrower and more definite transverse pale bands and by the darker ground colour, without the bluish sheen so often seen in fresh specimens of *punctipes*.

Holotype, male, Cameron Bay, Great Bear Lake, N.W.T., July 16, 1937, T. N. Freeman. Allotype, female, same locality and collector, July 20, 1937. Paratypes: 2, same locality and collector as holotype, Aug. 3, 1937; 6, Baker Lake, N.W.T., Aug. 2 to 8, 1947, T. N. Freeman; 5, Padlei, Keewatin, N.W.T., and 2, Mile 24 west of Dawson, Y.T., 3600 ft., July 31, 1949, P. F. Bruggemann.

Type No. 5942, Canadian National Collection.

***Dasyuris polata kidluitata*, new subspecies**

Fig. 9

This subspecies belongs to the pale, bluish-gray group, is of markedly larger size than the adjacent *punctipes* and *ursata*, and at first sight looks like a distinct species. The genitalia are, however, identical with those of the other *polata* subspecies, and the relationship is clear.

The ground colour is rather even, pale, lustrous and blue-gray, on which the dark bands appear narrowly and with little contrast, while the pale bands are hardly evident. One specimen has the medial area of the fore wing darkened, and one or two have a suggestion of orange scaling in the postmedial band.

Holotype, male, and allotype, female, Kidluit Bay, Richards Is., N.W.T., July 26, 1948, J. R. Vockeroth. Paratypes: 11, same locality as holotype, July 24 to 30, 1948, J. R. Vockeroth and W. J. Brown; 2, Yukon Territory, July 25, 1912, D. D. Cairnes.

Type No. 5943, Canadian National Collection.

Also one paratype in the collection of John L. Sperry, from Mt. Dewey, Alaska, 5500 ft., July 23, 1923.

***Dasyuris polata aleutiata*, new subspecies**

Fig. 10

The resemblance of *aleutiata* to the subspecies *bradorata*, from the opposite coast of North America, is striking. Both subspecies have a silvery-white

ground colour, with very prominent dark bands and a certain amount of ferrugineous scaling. The subspecies *aleutiata* differs from *bradorata* in having the dark bands on the average more prominent, and the ferrugineous scaling, when present, restricted to the postmedial band.

The types are all from Cold Bay, Alaska, collected in July, 1942, by B. H. Weber, and are distributed as follows:—

Holotype, male, and one male and one female paratype in the Los Angeles County Museum.

Allotype, female, and one male paratype in the Canadian National Collection, type No. 5944.

One male paratype in each of the following: United States National Museum; American Museum of Natural History, collection of Cornell University; collection of John L. Sperry, Riverside, Calif.

Dasyuris polata (Duponchel), Colorado population

Figs. 11, 12

From the poor and scanty material before me, I am unable to characterize this population adequately. The specimens seem to be dark, with the pale bands greatly reduced, and, as Forbes (1948) has noted, resemble *brullei*, from Greenland. The average size is, however, smaller, as in *punctipes*. The specimens are old and faded, and without better material I do not care to describe a Colorado subspecies.

Material examined: 6 specimens from Colorado, including 2 from Grant, Park Co., 9000 ft.; 1 from Bullion Peak, Park Co.; and 1 from Idaho Springs, 7500 ft.

Acknowledgments

I wish to thank Mr. J. G. Franclemont, United States National Museum; Mr. Lloyd M. Martin, Los Angeles County Museum; and Mr. John L. Sperry, Riverside, Calif., for loaning material and contributing information which had a bearing on this study.

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**Notes on the Lodgepole Needle Miner, *Recurvaria milleri* Busck
(Lepidoptera: Gelechiidae), and Its Parasites in
Western North America¹**

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Introduction

The lodgepole needle miner, *Recurvaria milleri* Busck, was discovered in 1903 in the Yosemite National Park, California, and was described as a new species by Busck (1914). The infestation has persisted in that area, with irregular periods of abundance and scarcity. The latest heavy infestation was reported (G. R. Struble, in litt.) to have started in 1947, and has continued to intensify. The history of the outbreak to 1919 was reported by Patterson (1921).

In 1942 a second important infestation was reported in the Banff National Park, Alberta. Details concerning the area of infestation and life-history notes were given by Hopping (1946). This infestation has continued to spread and has reached Yoho, Kootenay, and Revelstoke National parks.

The third important area of infestation is in the Cassia Division of the Minidoka National Forest in southeastern Idaho. This infestation was first reported (J. C. Evenden, in litt.) in 1948.

In August, 1950, a fourth area of infestation was reported (J. C. Evenden, in litt.) to have been found in the Targhee National Forest in eastern Idaho.

These four areas of infestation comprise the known distribution of *R. milleri*. Since three of the areas have been reported in the past eight years it seems evident that the insect is becoming an increasing threat to lodgepole pine in western North America.

In 1949 a project was initiated in co-operation with the Forest Insect Laboratory, Division of Forest Biology, at Calgary, Alta., to investigate the parasite complex in the areas of infestation with a view to introducing into Canada any important parasite species of *R. milleri* that were present in the United States and were not present in Canada. In 1950, when it was found that mortality during the winter of 1949-50 had caused an important reduction in the parasite population in Alberta, the scope of the project was widened to include the importation and colonization of all important parasite species.

Acknowledgments

The investigation of the United States areas of infestation and the procurement of material from which parasite colonies have been obtained for release in Canada would not have been possible without the assistance and co-operation of Dr. C. P. Clausen, United States Bureau of Entomology and Plant Quarantine, Washington, D.C.; Dr. F. P. Keen, Entomologist in Charge, and Mr. G. R. Struble of the U.S.D.A. Forest Insect Laboratory, Berkeley, California; and Mr. J. C. Evenden of the U.S.D.A. Forest Insect Laboratory, Coeur d'Alene, Idaho. Mr. H. A. Richmond, Forest Insect Laboratory, Victoria, B.C., and Mr. G. R. Hopping, Forest Insect Laboratory, Calgary, Alta., Canada Department of Agriculture, arranged for the release of these parasites.

Length of Life-Cycle of *R. milleri*

The length of the life-cycle of *R. milleri* varies between California, Idaho, and Alberta. In California all available records indicate that the insect requires two years to complete its life-cycle, moths emerging in odd-numbered years,

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i.e., 1945, 1947, 1949. There seems to have been no variation from this pattern during the 47 years that the insect has been present in that area. In Alberta from 1942 to 1949 the life-cycle was also completed in two years, but moths emerged in even-numbered years, i.e., 1944, 1946, 1948. In 1949, a year in which moth flight was not expected to occur, there was a large moth emergence. This indicates that a large number of the larvae completed their development in one year. The area of infestation in Idaho was investigated in 1949 and 1950, and in each year there was complete moth emergence.

The reason for the variation in the life-cycle in the three areas is not known. It may be due to climatic factors, or to genetical differences. The larvae from California are predominantly cream to light orange in colour, whereas those from Idaho and Alberta are predominantly dark orange to purple. There is also a difference in the numbers of crochets on the sixth abdominal and anal prolegs of the larvae from California and Idaho. The numbers of crochets on 35 larvae averaged 16.7 on the sixth abdominal and 11.25 on the anal prolegs for larvae from California, and 25.1 and 13.6 for those from Idaho. The t value was 1.13 for the anal crochets and 1.5 for the sixth-abdominal crochets, giving significance at the 14 and 12 per cent levels respectively. No other important larval, pupal, or adult differences have been noted.

Temperature or other weather factors may influence the length of time required to complete the life-cycle. The northernmost area of infestation, Alberta, is 800 miles north of the infested area in California, but is restricted to an altitudinal range of 4,500 to 6,500 feet, whereas in California the altitudinal range is from 7,000 to 9,000 feet. The difference in elevation partially compensates for the difference in longitude between the two areas. In 1949 the peak of moth flight occurred in California about July 20 and in Alberta about 10 days later. In Idaho, where the infestation is at an elevation of 7,500 to 8,000 feet, the peak of moth emergence occurred about July 25. The distribution of lodgepole pine and the areas of *R. milleri* infestation are shown in Figure 1.

The variability in the life-cycle of the host insect presents this biological control problem: Do the parasites synchronize their development with that of the host when the latter completes its development in either one or two years, or do they require alternate hosts when *R. milleri* takes two years to complete its life-cycle? It seems probable that species that parasitize the late-larval and pupal stages of *R. milleri* must depend on alternate hosts for their survival, for these stages are present only in alternate years in the form with the two-year life-cycle. Egg and early-larval parasites may not require an alternate host if their development is synchronized with that of the host.

The variability in the life-cycle may also influence the amount of damage to infested stands of lodgepole pine. In California, where the insect has a two-year life-cycle, no tree mortality has been reported as a direct result of needle miner attack. Considerable mortality has occurred because of attacks by the mountain pine beetle, *Dendroctonus monticolae* Hopk., following continued defoliation of the trees by *R. milleri*. In this area there is comparatively little defoliation during years in which there is no moth flight. This gives the trees an opportunity to recover from the effect of severe defoliation that occurs during years of moth flight, and only suppressed trees become subject to bark-beetle attack. In Idaho, where *R. milleri* completes its development in one year, the trees are subject to annual defoliation and serious damage may result if the needle miner population remains at a high level.

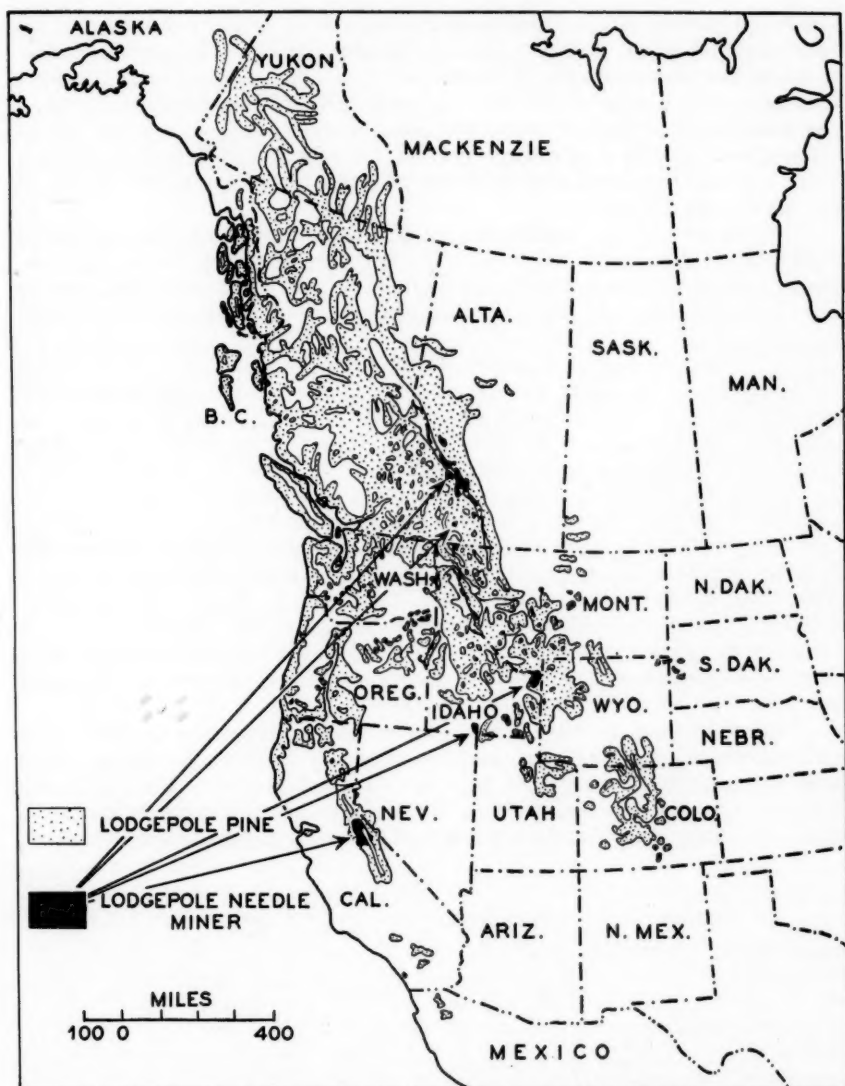


FIG. 1. Map of western North America showing distribution of lodgepole pine and areas infested with *R. milleri*, 1950.

Abundance of *R. milleri*

Information concerning the population of *R. milleri* in Idaho was obtained in 1950, when an attempt was made to determine the population on a heavily infested tree. A representative tree in a heavily infested area was stripped of needles. The tree was 67 years of age, 46 feet high, and 9 inches D.B.H., and the foliage extended from the crown to 31 feet above ground level. It was estimated by volumetric sample counts that there were 120,000 needles on the tree, of which 110,000 were infested. Each larva usually feeds in three needles

before completing its development, and on this basis it was estimated that the larval population was 40,000. After the infested needles were placed in incubation in the laboratory, 16,237 moths and 9,888 adult parasites were obtained, accounting for a total of 25,125. The remainder of the population, 14,875, was accounted for through larval and pupal mortality of the host and of the parasite, and through a percentage (10) of the parasites remaining in diapause. With a population of this size the insect threatens the virility if not the life of the heavily infested trees.

The severity of the infestation in Idaho is accentuated through annual defoliation by the needle miner with the one-year life-cycle, but at the same time a continuous host supply is provided for the parasites; hence they should increase more rapidly in areas with the one-year life-cycle than in those with the two.

Parasites of *R. milleri*

Patterson (1921) listed the following 10 species of parasites reared from prepupal larvae of *R. milleri* in California: *Aethecerus* sp., *Amblymerus* n. sp., *Angitia* sp., *Apanteles* n. sp., *Copidosoma* sp., *Elachertus* sp., *Epiurus* sp., *Habrocytus* n. sp., *Scambus* sp., and eulophid species.

At that time, 1919, *Copidosoma* sp. and *Amblymerus* sp. were said to be the most abundant. In 1936 and 1937 J. S. Yuill, Forest Insect Laboratory, Berkeley, California, investigated the California infestation and obtained considerable information concerning parasitism. He stated at that time (in litt.) that *Phaeogenes* sp., *Apanteles californicus* Mues., and *Amblymerus* sp. were the most numerous. The relative abundance of these species was not stated.

In 1949 infested needles obtained in California, Idaho, and Alberta were placed in incubation to determine the relative abundance of the more important parasites. The results are shown in Table I.

Table I does not show the true relative numerical importance of the parasite species because some of them pass the winter in the immature stages, e.g., *Sympiesis* sp. and *Neoderostenus* sp., a portion of which pass the winter in the larval and pupal stages respectively. The infested material from Alberta was placed in storage after parasite and moth emergence had ceased, and was placed

TABLE I
Relative abundance of the four most numerous parasites of
R. milleri in California, Idaho, and Alberta, 1949.

Species	Number	Per cent of total
CALIFORNIA		
<i>Apanteles</i> sp.....	5538	75.9
<i>Amblymerus</i> sp.....	905	12.4
<i>Phaeogenes</i> sp.....	325	4.4
<i>Neoderostenus</i> sp.....	168	2.3
IDAHO		
<i>Copidosoma</i> sp.....	1936	74.8
<i>Neoderostenus</i> sp.....	152	5.9
<i>Dicladocerus</i> sp.....	143	5.5
<i>Apanteles</i> sp.....	111	4.3
ALBERTA		
<i>Neoderostenus</i> sp.....	507	42.5
<i>Copidosoma</i> sp.....	284	23.8
<i>Sympiesis</i> sp.....	257	21.5
<i>Phaeogenes</i> sp.....	66	5.5

TABLE II
PARASITES REARED FROM *R. milleri* IN ALBERTA, 1949-50.

Species	1949	1950	Total
<i>Neoderostenus</i> sp.....	507	765	1272
<i>Sympiesis</i> sp.....	257	571	828
<i>Copidosoma</i> sp.....	284	0	284
<i>Phaeogenes</i> sp.....	66	19	85

in rearing again in May, 1950. The numbers of the more important species obtained through fall and spring rearing are shown in Table II.

In 1950 additional material from the infested area in Idaho was shipped by air express to the Dominion Parasite Laboratory, Belleville, Ont., and the Biological Control Investigations Laboratory, Vancouver, B.C. From the material reared at Belleville, 37,372 adults of the four most important parasite species were obtained. The parasite species in order of numerical importance were: *Copidosoma* sp., 63.5 per cent; *Neoderostenus* sp., 27.1 per cent; *Apanteles* sp., 7.3 per cent; and *Zagrammosoma* sp., 2.1 per cent. From the much smaller amount of material reared at Vancouver, 1,649 adults of the four most important parasite species were reared. The same order of importance was obtained, the values being: *Copidosoma* sp., 83.1 per cent; *Neoderostenus* sp., 13.3 per cent; *Apanteles* sp., 2.0 per cent; and *Zagrammosoma* sp., 1.6 per cent. From samples of infested needles that were dissected at Vancouver after parasite emergence had ceased it was found that fewer than 80 per cent of the living parasites had emerged. The remainder, which were in the larval and pupal stages, can be expected to emerge during the summer of 1951.

The difference in the degree of parasitism in tree crowns and in the lower branches was investigated. Eight hundred and eighteen infested needles taken from more than 30 feet above ground and 970 taken from less than 30 feet above ground were placed in one-inch shell vials. Emergence was recorded as it occurred; and after emergence was complete, the needles were dissected. The results are shown in Table III.

The indicated percentage of *R. milleri* destroyed by parasites was probably considerably lower than the actual percentage; since it was impossible to determine the presence or absence of parasitism in the dead larvae and pupae of the host, they were classed as unparasitized. It should be noted that the number of *R. milleri* from which parasites emerged was considerably lower than the total parasite emergence; this was due to polyembryony, multiparasitism, and superparasitism. This also explains the apparent anomaly of the larger number of parasites and the lower percentage of *R. milleri* destroyed in material obtained from more than 30 feet above ground, and the smaller number of parasites and higher percentage of *R. milleri* destroyed in material obtained from less than 30 feet above ground.

The most numerous parasite of *R. milleri* and one of the most widely distributed is *Copidosoma nanellae* auct., nec Silv. This species is polyembryonic and produces as many as 14 adults from one egg in a single host. From 205 *R. milleri* larvae in which there were no secondary parasites and that were parasitized by *C. nanellae*, 467 male and 850 female adults were obtained, an average of 6.7 per host. In no instance did males and females emerge from the same host, an indication that not more than one colony can develop in a single host. *C. nanellae* is an internal larval parasite that pupates within the dried

TABLE III
PARASITISM OF *R. milleri* IN IDAHO, 1950

	Source	
	More than 30 ft. above ground	Less than 30 ft. above ground
Infested needles.....	970	818
Dead pupae.....	172	136
Dead larvae.....	74	106
Dead moths.....	53	44
Live larvae.....	1	0
Live moths.....	405	165
Total <i>R. milleri</i> unaffected by parasites.....	705	451
Dead parasites.....	19	36
Live parasites unemerged.....	17	91
<i>R. milleri</i> from which parasites emerged.....	229 (1,041 ²)	240 (779 ²)
Total <i>R. milleri</i> destroyed by parasites.....	265 (27.3%)	367 (44.9%)

²Total parasite emergence.

remains of the host, which then becomes distended and chain-like in appearance. Under laboratory conditions there is complete adult emergence during August.

Neoderostenus sp. is an important parasite species in Idaho and Alberta, but seems to be of less importance in California. It usually completes its development in the host pupa and forms a naked, black pupa typical of this and other eulophids. It may also develop as a secondary parasite on *C. nanellae*, pupating within the host cocoons and destroying part or all of the primary parasites. Forty-two colonies of *C. nanellae* parasitized by *Neoderostenus* sp. produced an average of three adults per colony, or about 50 per cent of the normal number. All adults of *Neoderostenus* sp. that were reared from *C. nanellae* were males. The number of individuals obtained per host ranged from one to five. In 1949 more than 50 per cent of the population reared in the laboratory from material obtained in Alberta remained in the pupal stage during the winter; a somewhat smaller part of the population obtained in Idaho in 1950 remained in diapause.

Apanteles californicus Mues. is the most important parasite of *R. milleri* in California but is of considerably less importance in Idaho and Alberta. It emerges from the host larva and spins a loose, silken, white cocoon in the mined needle near the remains of the host. Adults emerge during late July and August.

Zagrammosoma americana Gir. was taken in significant numbers from California, Idaho, and Alberta. It emerged from the host larva and also from cocoons of *C. nanellae*. All adults recovered from the latter host were males.

Dicladocerus sp., an internal larval parasite, is present in both California and Idaho, but has not been found in Alberta.

Sympiesis sp. is believed to be an external larval parasite and seems to be more abundant in Alberta than in either of the other two areas. A large part of the population of this parasite passes the winter in the larval stage within the mined needles.

The first colonies of parasites were released in the Alberta area of infestation in 1949. In 1950, more extensive releases were made, the numbers being: 1,370 *A. californicus*, 142 *Dicladocerus* sp., 2,024 *Neoderostenus* sp., 29 *Sympiesis* sp., and 1,616 *Zagrammosoma* sp.

Summary

The lodgepole needle miner, *Recurvaria milleri* Busck, is becoming an increasingly important pest of lodgepole pine in western North America. It was discovered in 1903 in the Yosemite National Park, California, where a population has persisted with irregular periods of abundance and scarcity. From 1942 to 1950, three new areas of infestation have been reported: two in Idaho and one in Alberta. In California the insect requires two years to complete its life-cycle, the moths emerging in odd-numbered years. In Alberta it also requires two years, but moths normally emerge in even-numbered years; in 1949, however, a considerable part of the population completed its development in one year. In Idaho the insect has completed its development in one year in each of the two years that it has been observed. There are numerous species of parasites present in all areas. The most important of these are: *Copidosoma nanellae* auct., nec. Silv., *Neoderostenus* sp., *Apanteles californicus* Mues., *Symptesis* sp., *Zagrammosoma americana* Gir., and *Dicladocerus* sp. The latter species has been found in both California and Idaho, but not in Alberta. All other species have been found in each of the three areas that have been investigated.

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Notes on *Phanerotoma tibialis* (Hald.) and *P. fasciata* Prov., with Descriptions of Two New Species (Hymenoptera: Braconidae)¹

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For many years American workers have applied the name *Phanerotoma tibialis* (Hald.) indiscriminately to specimens reared from a variety of lepidopterous hosts pertaining to the genera *Acrobasis*, *Carpocapsa*, *Grapholitha*, *Laspeyresia*, *Melissopus*, and *Tetralopha*. Concurrently *tibialis* has come to be regarded as an unusually variable species in both structure and colour. Recently, after examining many specimens reared from the above hosts, I reached the conclusion that two species of *Phanerotoma* are involved, one a parasite of Pyralidae of the phycitid and epipachiinid groups, and the other a species that apparently confines its attacks to certain Olethreutidae of the subfamily Eucosminae. For reasons stated below it appears that the name *Phanerotoma tibialis* (Hald.) applies correctly to the species with pyralid hosts (*Acrobasis*, *Tetralopha*), whereas the species reared from Olethreutidae (*Carpocapsa*, *Grapholitha*, *Laspeyresia*, *Melissopus*) should be called *Phanerotoma fasciata* Prov.

The recognition of two very similar species of *Phanerotoma*, each with apparently rather distinct biological requirements, should prove of interest to workers engaged in problems of applied biology relating to pests pertaining to the aforementioned groups; for the success or failure of the laboratory propa-

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gation, field colonization, or introduction of these *Phanerotoma* species may rest to a greater extent on the suitability of the host material than has hitherto been appreciated.

Both *P. tibialis* (Hald.) and *P. fasciata* Prov. are highly variable species in colour, and vary to some extent in structure, especially in sculpture and in details of wing venation. The principal distinctions are tabulated below. A reliable character for their separation is found in the form of the hypopygium of the female; and one of the most easily recognized differences is the presence in *tibialis*, and the absence in *fasciata*, of a rather large fuscous spot behind the eye. Unfortunately, however, the latter character is not entirely reliable, in that in occasional examples of *tibialis* the spot may be very faint or absent.

P. tibialis (Hald.)

Eyes large and very prominent.

Lateral ocelli large, their greatest diameter distinctly greater than the distance between them.

Female with the 4 or 5 segments immediately preceding the apical segment of antenna not longer than broad.

Recurrent vein usually received near base of second cubital cell, rarely interstitial with first intercubitus.

Female with posterior margin of hypopygium acutely, triangularly produced at middle.

Head pale honey-yellow, except in region of ocelli, also usually with a rather large, more or less distinct fuscous spot behind the eye.

P. fasciata Prov.

Eyes slightly smaller and less prominent.

Lateral ocelli smaller, their greatest diameter frequently less and never distinctly greater than the distance between them.

Female with the 4 or 5 segments immediately preceding the apical segment of antenna slightly longer than broad.

Recurrent vein usually interstitial with first intercubitus, rarely entering second cubital cell very close to base.

Female with posterior margin of hypopygium broadly angulate (approximately a right angle) at middle.

Head very variable in colour, ranging from largely pale honey-yellow to entirely fuscous, but never with a discrete fuscous spot behind the eye.

Phanerotoma tibialis (Hald.)

1849 *Sigalphus tibialis* Haldeman, Proc. Acad. Nat. Sci. Phila., IV, 203.

1872 *Phanerotoma tibialis* (Haldeman), Cresson, Trans. Am. Ent. Soc., IV, 181.

1881 *Phanerotoma tibialis* (Haldeman), Grote, Papilio, I, 14.

1928 *Phanerotoma tibialis* (Haldeman), Muesebeck in Leonard, Cornell Univ. Agr. Expt. Sta. Mem., 101, p. 903. [in part]

1930 *Phanerotoma tibialis* (Haldeman), Johnson, Pub. Nantucket Maria Mitchell Assoc., III (2), p. 95.

1941 *Phanerotoma tibialis* (Haldeman), Snodgrass, Smithsonian Misc. Coll., 99, No. 14, p. 35. [morphology]

1950 *Phanerotoma tibialis* (Haldeman), Nickels, Pierce, and Pinkney, U.S. Dept. Agr. Tech. Bull., 1011, pp. 19, 21.

In 1849 Haldeman described *tibialis* from specimens taken in "S.E. Pennsylvania." His description, which does not mention the host, is devoted almost entirely to the colour pattern, and in this respect agrees, except in one particular, almost equally well with the present species and the one that follows. However, the mention of the presence of a fuscous macula behind the eye agrees with the species now known to be a parasite of certain members of the family Pyralidae and not with *fasciata* as recognized below. Haldeman's type apparently no longer exists and it seems reasonable therefore to accept his description as applying to the present species. This interpretation also accords with the earliest host record, namely, that of Grote (1881), in which specimens of *tibialis*, determined by E. T. Cresson, were reported as reared from the pyralid *Acrobasis caryae* Grote. The exact type locality for *tibialis* is not known but the presence of the species in southern Pennsylvania is confirmed by a specimen at hand, which was taken at Shippensburg, Pa., and which conforms very closely with Haldeman's description.

Thirty-three specimens of this species have been studied, of which 26 have a distinct fuscous spot behind the eye. In three of the remaining seven specimens the spot is present but very faint, and in the other four there is no trace of a spot. These seven specimens are from southern regions (Arkansas, Florida, and Texas), and in common with six of the eight other specimens from the same areas they have the usual fuscous markings on the head, thorax, and abdomen greatly reduced in comparison with the remaining 18 specimens from northern regions (Ontario, Quebec, and Pennsylvania).

From what is now known concerning the host requirements for this species it is believed that the majority of the records for *tibialis* should be assigned to *fasciata* (see below). A few records, in which host data are omitted, cannot be evaluated and accordingly are included under the present species. The meagre information in the literature concerning the distribution and habits of the species is considerably extended by a study of the material at hand; this establishes the presence of the species in Ontario (Ottawa district, Vineland Station), Quebec (Old Chelsea), Arkansas (Bentonville), Florida (Monticello, Palm Beach), Illinois (Coquillett specimen, without locality data), Pennsylvania (Shippensburg), and Texas (Brownwood, College Station, Cuero). In Quebec it has been reared from *Tetralopha asperatella* Clem., and in Ontario from *Acrobasis caryae* Grote, *A. rubrifasciella* Pack., and *A. sylviella* Ely. It has been reared in Arkansas from *Acrobasis* sp., in Florida and Illinois from *Acrobasis caryae* Grote, and in Texas from the latter and also from *A. caryivorella* Rag.

Two specimens of *tibialis* at hand are labelled as reared from *Proteropteryx* [*Gretchena*] *deludana*, at Cuero, Texas, by M. M. High (Chittenden No. 1899). As *Gretchena* belongs to the olethreutid subfamily Eucosminae, this record, if correct, is of unusual interest insofar as it is evidence that at least under some circumstances *tibialis* does not confine its parasitism to the family Pyralidae. However I believe there are reasons for accepting the record with reservation until it is confirmed by further rearings. It is to be noted that the distribution given for *G. deludana* (Clem.) by Heinrich (U.S. Nat. Mus. Bull. 123: 181. 1923) included only Maryland, Pennsylvania, Virginia, and New Jersey. Heinrich further remarks that in economic literature *deludana* has often been recorded as a pecan feeder on account of its confusion with *G. bolliana* Sling. It is further significant that *bolliana* is a common pest of pecans in Texas, and that there it is often found in association with other pecan feeders, notably *Acrobasis caryae* Grote. If, as seems not improbable, the specimens of *tibialis* from Cuero, Tex., were reared from pecan-feeding larvae a misassociation of parasite and host might readily arise.

Phanerotoma fasciata Prov.

- 1881 *Phanerotoma fasciata* Provancher, Nat. Can. XII, 200.
- 1881 *Phanerotoma tibialis* (Haldeman), Comstock, [U.S.] Ann. Rept. Comm. Agr. for 1880, p. 255.
- 1883 *Phanerotoma fasciata* Provancher, Provancher, Pet. Faune Ent. du Can., II, 534.
- 1890 *Phanerotoma* (*Sigalphus*) *tibialis* (Haldeman), Hamilton, Ent. News, I, 49.
- 1895 *Phanerotoma tibialis* (Haldeman), Chittenden, Insect Life, VII, 350.
- 1908 *Phanerotoma tibialis* (Haldeman), Pierce, J. Econ. Ent., I, 387.
- 1910 *Phanerotoma tibialis* (Haldeman), Smith, N.J. State Mus. Rept. (1909), p. 612.
- 1915 *Phanerotoma tibialis* (Haldeman), Brooks, and Blakeslee, U.S. Dept. Agr. Bull., 186, p. 46.
- 1917 *Phanerotoma tibialis* (Haldeman), Worsham, Ga. State Board of Ent. Bull., 48, p. 25.
- 1917 *Phanerotoma tibialis* (Haldeman), Viereck, Conn. Geol. Nat. Hist. Surv. Bull., 22, p. 233.
- 1924 *Phanerotoma tibialis* (Haldeman), Wehrle, Cornell Univ. Agr. Expt. Sta. Bull., 428, p. 27.
- 1926 *Phanerotoma tibialis* (Haldeman), Dozier, Univ. Del. Agr. Expt. Sta. Bull., 147, p. 18.
- 1926 *Phanerotoma tibialis* (Haldeman), Stearns, N.J. Agr. Expt. Sta. Rept. for year ending June 30, 1926, p. 191.

- 1928 *Phanerotoma tibialis* (Haldeman), Selkregg and Siegler, U.S. Dept. Agr. Tech. Bull., 42, p. 52.
- 1928 *Phanerotoma tibialis* (Haldeman), Muesebeck in Leonard, Cornell Univ. Agr. Expt. Sta. Mem., 101, p. 903. [in part]
- 1929 *Phanerotoma tibialis* [author omitted], Dozier, Buller, and Williams, Univ. Del. Agr. Expt. Sta. Bull., 162, p. 33.
- 1930 *Phanerotoma* (!) *tibialis* (Haldeman), Adair, Quart. Bull. State Plant Board Miss., IX (4), p. 3.
- 1930 *Phanerotoma tibialis* (Haldeman), Haeussler, J. Agr. Res., XLI, 367, 371, 377.
- 1934 *Phanerotoma tibialis* (Haldeman), Strong, Rept. of the Chief, Bur. Ent. and Plant Quar., p. 4. U.S. Dept. Agr.
- 1937 *Phanerotoma tibialis* (Haldeman), Strong, Rept. of the Chief, Bur. Ent. and Plant Quar., p. 3. U.S. Dept. Agr.
- 1937 *Phanerotoma tibialis* (Hold.), (!), Webb, J. Econ. Ent., XXX, 681.
- 1938 *Phanerotoma tibialis* (Haldeman), Britton, Conn. Geol. Nat. Hist. Surv. Bull., 60, p. 120.
- 1938 *Phanerotoma fasciata* Provancher, Brimley, Ins. N.C., p. 400.
- 1938 *Phanerotoma tibialis* (Haldeman), Brimley, Ins. N.C., p. 400.
- 1940 *Phanerotoma tibialis* (Haldeman), Webb and Alden, J. Econ. Ent., XXXIII, 434.
- 1940 *Phanerotoma tibialis* (Haldeman), Dohanian, J. Econ. Ent., XXXIII, 855.
- 1940 *Phanerotoma tibialis* (Haldeman), Garman, Conn. Agr. Expt. Sta. Circ., 140, p. 33.
- 1941 *Phanerotoma* sp. Boyce, Seventy-first Rept. Ent. Soc. Ont. (1940), p. 41.
- 1942 *Phanerotoma tibialis* (Haldeman), Dohanian, J. Econ. Ent., XXXV, 837, 838.
- 1943 *Phanerotoma* sp. Wishart, Can. Ent., LXXV, 237.
- 1944 *Phanerotoma tibialis* (Haldeman), Lloyd, Sci. Agr., XXIV, 468.
- 1950 *Phanerotoma fasciata* Provancher, Nickels, Pierce, and Pinkney, U.S. Dept. Agr. Tech. Bull., 1011, pp. 19, 21.

Provancher (1881) described *fasciata* from a female, probably taken in the vicinity of the City of Quebec. The type is now in the Provancher Collection at the Quebec Provincial Museum. In the numerous specimens at hand the head varies in colour from entirely pale, except for the ocellar region, to wholly dark brownish or black. Among the paler specimens the fuscous markings sometimes extend downward from the ocelli to the bases of the antennae and backward from the vertex to include more or less of the occiput. In other examples there is a gradual extension of the dark areas to include the entire vertex, more or less of the face, and the occiput on to the genae. The last areas to be invaded by fuscous are the lower part of the face, the clypeus, and the posterior orbits. Even among the darker specimens, however, there is no tendency toward the formation of a discrete fuscous spot behind the eye. As may be expected, specimens in which the head is predominantly pale, usually also have the thorax with extensive pale markings, and conversely, when the head is extensively fuscous the thorax is largely or entirely black. Provancher's description applies very well to the paler individuals noted above; and certain of these have recently been compared with the type of *fasciata*, for me, by Mr. Noel. M. Comeau.³ From Mr. Comeau's comparisons I am satisfied that the identification of the species is correct.

As now recognized, this species is a widely distributed parasite of a number of important lepidopterous pests pertaining to the family Olethreutidae. I have examined material reared from *Carpocapsa pomonella* (L.), *Grapholitha molesta* (Busck), *Laspeyresia caryana* (Fitch), *L. nigricana* (Steph.), and *Melissopus latiferreanus* (Wlsm.). It has been reported many times in the literature (under the name *tibialis*) from these hosts, and also from *Grapholitha interstinctana* (Clem.). Mr. C. F. W. Muesebeck has also recently informed me that among the material in the collections of the United States National Museum there is a

³In his notes on the type of *fasciata* Mr. Comeau calls attention to the presence of a conspicuous rounded tubercle on the face. Recently, Mr. John Martin, of Belleville, Ont., examined the type, and his notes, which he kindly made available to me, also direct attention to this unusual feature. Inasmuch as in a few specimens of *fasciata* that I have seen there is a more or less distinct median longitudinal elevation on the face, and in one specimen a distinct low tubercle above the clypeus, I am inclined to regard Provancher's type as no more than an unusual variant in this respect.

series of this species reared from *Grapholitha packardi* Zell., at Beaumont, Texas, in 1944.

In the same year in which Provancher described *fasciata* it was reported by Comstock as a parasite of the clover head caterpillar, *Grapholitha interstinctana* (Clem.), at Washington, D.C. It was again reared from this host at Ithaca, N.Y., by Wehrle (1924), on whose work the record by Leonard (1928) is also based.

In New Jersey, Stearns (1926), and Haeussler (1930) recorded the species as a parasite of the oriental fruit moth, *Grapholitha molesta* (Busck), and it was reported from the same host in North Carolina by Brimley (1938). Britton (1938) noted its liberation in Connecticut orchards as an aid in controlling the oriental fruit moth. The Canadian National Collection contains material reared from *G. molesta* at Vineland Station, Ont.

John Hamilton (1890) of Allegheny, Pa., reared the species from hickory nuts infested with *Laspeyresia caryana* (Fitch). Smith (1910) reported it from this host in New Jersey, and subsequently it has been reared from *L. caryana*, on pecan, in Georgia, by Worsham (1917) and in Mississippi by Adair (1930). Recently Nickels, Pierce, and Pinkney (1950) stated that it is the most important parasite of the shuckworm [*L. caryana*] on pecan in Texas. In Ontario, the species has been reared from *L. caryana*, on hickory, in Prince Edward County and at Ottawa, St. Davids, and Vineland Station.

Under the name *Phanerotoma* sp., Wishart (1943) recorded rearings of this species in southern British Columbia, from the pea moth, *Laspeyresia nigricana* (Steph.), from which stock specimens were obtained for liberation against the same pest in Nova Scotia. The British Columbia material at hand differs from most eastern collections in its generally darker colour.

The species has been reported on several occasions as a parasite of the codling moth, *Carpocapsa pomonella* (L.): in Virginia by Brooks and Blakeslee (1915), in Delaware by Selkregg and Siegler (1928) and by Dozier, Buller, and Williams (1929), and in Georgia by Webb (1937) and by Webb and Alden (1940); also in Ontario (as *Phanerotoma* sp.) by Boyce (1941). In Delaware, Dozier (1926) found specimens in an apple packing warehouse in which both the codling moth and the oriental fruit moth were present in numbers. Strong (1937) recorded liberations of the parasite in Idaho, to combat the codling moth, and noted (1934) the shipment of specimens to New Zealand for the same purpose.

Dohanian (1940) reared this species from the filbertworm, *Melissopus latiferreanus* (Wlsm.), on filberts, in Oregon, and subsequently (1942) noted its presence in several west coast states, particularly Oregon and Washington, where he reared it from acorns infested with *M. latiferreanus*, and also from galls, formed by *Cynips maculipennis*, in which larvae of *M. latiferreanus* were living. In Eastern Canada the species has been reared from *M. latiferreanus* by W. L. Putman, at Vineland Station and St. Davids, Ont.

Chittenden's record (1895) of this species as a probable parasite of the weevil *Anthonomus nigrinus* Boh. should in all probability be rejected, as has been suggested by Pierce (1908).

***Phanerotoma thapsina* n. sp.**

This species may be recognized by its rather uniform tawny-yellow colour, the number of antennal segments (male 28-29, female 31-32), and especially by the somewhat shining and densely punctate but otherwise unsculptured head and thorax.

Female.—Length 4.5 mm. Head large, slightly broader than thorax; eyes prominent, nearly circular in outline; face a little less than twice as broad as long

from antennae to base of clypeus, shining and finely, evenly, and rather densely punctate; clypeus more sparsely punctate; malar space .60 basal width of mandible; frons, vertex, and temples shining, rather densely punctate; temples rather strongly convex, slightly receding, about as wide as length of ocellocular line; antenna 32-segmented; scape 1.5 times as long as thick; flagellum rather stout, the majority of the segments (all except the basal 10) not longer than broad.

Thorax shining, punctures larger and more dense than on head; punctures on the pronotum distinct except along sulcus, where they are confused with a number of transverse rugae; mesoscutum very densely punctured, the intervals between punctures for the most part narrower than diameter of a puncture, punctures along notaulices frequently confluent; scutellum and mesopleura with numerous, distinct punctures; metapleura with dense, often confluent, punctures; propodeum with coarse, irregular punctures confused with irregular rugulae; transverse propodeal carina present, but irregular, subtuberculiform at lateral extremities; wing venation very similar to *P. tibialis* (Hald.).

Abdomen moderately depressed, about as broad as thorax; three visible tergites of approximately equal length, the first with the usual pair of convergent keels on basal half, the apex of the third only moderately broadly truncate (the truncate margin viewed from behind appearing in the form of a broad, shallow emargination); tergites with numerous, irregular, longitudinal rugulae, which are most pronounced on tergites one and two, intervals between rugulae with fine, irregular sculpture; hypopygium not extending beyond apex of abdomen, posterior margin forming an angle of about 60 degrees; sheath short, exerted only slightly beyond apex of abdomen.

Body of slightly varying shades of tawny-yellow; stemmaticum brownish; antennae yellowish-brown; wings with fuscous maculae as in *P. tibialis*; legs without pronounced darker markings.

Male.—Antenna 29-segmented, segments of flagellum very gradually diminishing in length distally, the terminal 6-8 segments not distinctly longer than broad; abdomen more narrowly truncate at apex than in female.

Holotype.—♀, Port Isabel, Cameron Co., Texas, June 20-23, 1948.

Allotype.—♂, same data as holotype.

Paratypes.—2 ♂♂, 18 ♀♀, same data as holotype; ♀, Georgetown, Texas, Apr. 30, 1937 (L. J. Milne).

Holotype, allotype, and paratypes, No. 5949 in Canadian National Collection, Ottawa, Canada. Paratypes in United States National Museum.

The Port Isabel specimens of this species have been kindly provided by my colleague, Mr. W. R. M. Mason, with the further information that they were collected "at light" by Messrs. H. E. Evans and G. E. Ball.

***Phanerotoma longicauda* n. sp.**

This species is most easily distinguished from other Nearctic members of the genus by the exceedingly long, slender sheath and ovipositor in the female. In this respect it evidently is very similar to *Phanerotoma noctivaga* Marshall,⁴ a West Indian species described and as yet known only from the Island of Antigua. In other respects the present species is most similar to *P. recurvariae* Cush., with which it agrees in size, wing venation, and sculpture. *Recurvariae*, however, differs in the stouter antennae, less deeply emarginate apex of abdomen and shorter ovipositor sheath.

Female.—Length 3 mm. Head large, subquadrate, excavated behind; eyes rather prominent, nearly circular in outline; face a little less than twice as broad

⁴Trans. Ent. Soc. Lond., p. 112, 1885.

as long from antennae to base of clypeus (7: 4), finely shagreened and somewhat shining; clypeus rather smooth and shining; malar space .70 basal width of mandible and .29 greatest diameter of eye; frons, vertex, and temples finely shagreened, occasionally with traces of rugulae especially on the vertex; temples convex, slightly receding, about as wide as length of ocellocular line; antenna 23-segmented; scape fully twice as long as thick; flagellum rather slender, not noticeably thicker at middle than at base.

Thorax narrower than head, shagreened, somewhat granular and opaque on mesoscutum; propodeum finely, irregularly rugulose and with an irregular transverse carina near the middle; first abscissa of radius a little shorter than second, sloping slightly toward base of wing; first intercubitus interstitial with recurrent vein; nervulus oblique, post-furcal by its own length; second cubital cell unusually broad near apex, strongly narrowed to a point at base.

Abdomen moderately depressed, about as broad as thorax; first tergite equal in length to second, distinctly shorter than third, with two convergent keels arising at basal lateral margins and extending to middle of tergite; second tergite twice as broad as long; third tergite strongly, roundly emarginate at apex; tergites with numerous irregular longitudinal rugulae which tend to become more irregular beyond the base of the third tergite; hypopygium lanceolate, the apical portion very slender and acute; entire sheath distinctly longer than abdomen, exerted portion slightly longer than abdomen beyond apex of first tergite.

Head yellowish-testaceous with the stemmaticum and surrounding area from base of antennae to occiput blackish; antenna fuscous; prothorax dull testaceous, remainder of thorax and propodeum blackish; tegulae yellowish; base of first tergite brownish, third tergite black, remainder of tergites dull testaceous; legs pale yellowish-testaceous; hind femur narrowly dusky at apex; hind tibia broadly fuscous at the apex and more narrowly and less distinctly so at base, a similar pattern more faintly repeated on front and middle tibiae; hind tarsus fuscous; stigma dark brown, paler at extreme base, wing with a faint brownish cloud just below the stigma.

Male.—In most respects very similar to the female. Abdomen without distinct emargination at apex.

Holotype.—♀, Aylmer, Que., July 15, 1924 (C. H. Curran).

Allotype.—♂, Queens Park, Aylmer, Que., Aug. 25, 1924 (A. R. Graham).

Paratypes.—ALBERTA: ♂, Black Foot Hills, Aug. 7, 1940 (A. R. Brooks). FLORIDA: ♂, Lafayette Co., Apr. 18, 1930 (J. K. Mizell); ♀, Manatee Co., Mar. 19, 1930 (R. F. Tinker); ♂, 2 ♀ ♀, Monticello, "Pecan", July 28, 1914, Aug. 14, 21, 1915 (John B. Gill); ♂, Orange Co., "Fla. fruit fly trap survey", Jy. 5, 1929 (C. J. Guard); ♂, ♀, Pinellas Co., "Fla. fruit fly trap survey", Mar. 29, Apr. 19, 1930 (B. P. Moore); 4 ♀ ♀, Winter Park, "light", Jy. 15, Aug. 18, 28, 1939. ILLINOIS: ♀, White Heath, June 13, 1939 (J. C. Dirks). IOWA: ♀, Dickinson Co., June 26, 1936 (B. Millspaugh); Linn. Co., June 19, 1934 (H. E. Jaques); Wright Co., Aug. 3, 1934 (H. E. Jaques). MARYLAND: ♂, ♀, Cabin John, June 30, 1917, Jy. 16, 1924 (R. M. Fouts). MICHIGAN: ♀, Crawford Co., Jy. 1, 1939 (D. S. Bullock, R. R. Dreisbach); ♀, Roscommon Co., Jy. 2, 1939 (D. S. Bullock, R. R. Dreisbach). ONTARIO: ♀, Grand Bend, Jy. 7, 1939 (G. E. Shewell); ♀, Simcoe, June 15, 1939 (G. E. Shewell); 3 ♀ ♀, Simcoe, June 19, 1939 (G. S. Walley); ♀, Smoky Falls, Mattagami River, Jy. 28, 1934 (G. S. Walley). PENNSYLVANIA: ♀, North East, June 25, 1915. QUEBEC: 3 ♀ ♀, Aylmer, Jy. 18, 1924 (C. H. Curran); ♀, Queens Park, Aylmer, Jy. 23, 1926 (C. B. Hutchings). TENNESSEE: 2 ♀ ♀, Hamilton Co., "peach orchard", July 24, Aug. 8, 1939, lot nos. 39-13476 and 39-13936; ♀, Nashville, "Elm-Maple Forest", June 18, lot no.

38-3322. VIRGINIA: ♀, Vienna, "Parasite on *Carposina* sp.", issued May 13, 1937 (J. C. Bridwell); ♀, Vienna, May 30, 1933 (H. G. Barber).

Holotype, allotype, and paratypes, No. 5950 in Canadian National Collection, Ottawa, Canada. Paratypes in United States National Museum.

Host.—Despite the numerous specimens at hand the only host datum for this species is provided by a single example from Virginia, which according to the information provided was reared from *Carposina* sp. (family Carposinidae).

Remarks.—This species exhibits great variation in colour, specimens from northern localities being much darker than those from the south. Among the former, examples occur in some, the entire thorax and abdomen are fuscous and in others the abdomen is blackish except for a small, obscure, dull, testaceous central spot. Specimens from Florida are notably paler than those from other regions, usually having the entire head and thorax pale testaceous or yellowish and sometimes the abdomen almost uniformly pale.

Specimens of this species, and also of *P. tibialis*, from United States localities are contained in the collections of the United States National Museum and have been made available to me for study through the kindness of Mr. C. F. W. Muesebeck.

A Review of the North American Species of *Herina* Robineau-Desvoidy (= *Tephronota* Loew) (Diptera: Otitidae)¹

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The discovery of a new species of *Herina* Desv. [= *Tephronota* Loew] has provided the opportunity of reviewing the genus in North America. In the following discussion, which includes a description of the new species and a key to the four recognized Nearctic species, I also present notes on nomenclature, distribution, and relationships between species.

Herina Robineau-Desvoidy

Herina Desv., 1830, Essai sur les Myodaires, p. 724; Becker, 1905, Kat. Pal. Dipt. 4: 97; Séguy, 1934, Faune de France 28: 59; Hennig, 1939, in Die Fliegen der Palaearktischen Region, ed. by Lindner, [Fasc.] 46, 47: 59; Kloet and Hincks, 1945, Check List Br. Ins., p. 384.

Genotype: *Musca germinationis* Rossi, 1790 [= *Hecrina liturata* Desv., 1830]—a European species, the earliest described of the recognizable species of Desvoidy—designated by Hennig, 1939.

Synonyms: *Loxodesma* Loew, 1868, Zeitschr. f. Ges. Naturw. 32: 6; Loew and Osten Sacken, 1873, Monogr. Dipt. N. Amer. 3: 55; Becker, 1905, Kat. Pal. Dipt. 4: 97; Séguy, 1934, Faune de France 28: 58; Hennig, 1939, in Die Fliegen der Palaearktischen Region, ed. by Lindner, [Fasc.] 46, 47: 59; Kloet and Hincks, 1945, Check List Br. Ins., p. 384. Genotype: *Ortalis lacustris* Meig., 1826, by designation of Loew, 1873.

Pteropaectria Loew, 1868, Zeitschr. f. Ges. Naturw. 32: 5; Loew and Osten Sacken, 1873, Monogr. Dipt. N. Amer. 3: 56; Hennig, 1939, in Die Fliegen der Palaearktischen Region, ed. by Lindner, [Fasc.] 46, 47: 59; Kloet and Hincks, 1945, Check List Br. Ins., p. 384. Genotype: *Ortalis palustris* Meig., 1826, by designation of Loew, 1873.

Thryophila Loew, 1868, Zeitschr. f. Ges. Naturw. 32: 6; Loew and Osten Sacken, 1873, Monogr. Dipt. N. Amer. 3: 56; Hennig, 1939, in Die Fliegen der Palaearktischen Region, ed. by Lindner, [Fasc.] 46, 47: 59; Kloet and Hincks, 1945, Check List Br. Ins., p. 384. Genotype: *Musca frondescens* Linné, 1758, by designation of Loew, 1873.

Tephronota Loew, 1868, Zeitschr. f. Ges. Naturw. 32: 6; Loew and Osten Sacken, 1873, Monogr. Dipt. N. Amer. 3: 56-57; 122-123; Aldrich, 1905, Cat. N. Amer. Dipt., p. 591; Becker,

¹Contribution No. 2845, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada; in co-operation with the National Defence Research Board.

²Technical Officer.

1905, Kat. Pal. Dipt. 4: 99; Coquillett, 1910, Proc. U.S.N.M. 37: 613; Curran, 1934, N. Amer. Dipt., p. 281; Ségué, 1934, Faune de France 28: 62; Hennig, 1939, in Die Fliegen der Palaerktischen Region, ed. by Lindner, [Fasc.] 46, 47: 59. Genotype: *Ortalis gyrans* Loew, 1864 [= *Herina tristis gyrans* (Loew)], by designation of Loew, 1873.

Herina Desv. may be distinguished from other genera of the Otitidae by the following combination of characters: facial ridge and antennal foveae distinct; front and cheeks narrow, front at vertex not as wide as the distance from the foremost ocellus to its anterior margin, width of cheek not more than one-sixth to one-quarter of the vertical height of the eye; third antennal segment not strongly concave on its upper margin, often with a distinct but not very sharp angle at its apex. Several mesopleural but only one sternopleural bristle; propleural bristle always present; two supra-alars, two postalars, and usually two dorso-centrals present. First vein with dorsal setulae on the apical third; costa not greatly weakened at the apex of the auxiliary vein; third and fourth veins nearly parallel at their apices, never strongly convergent.

Nearctic species of this genus have been heretofore known under the generic name *Tephronota* Loew. If Loew's work can be accepted in so far as he placed in his genus *Tephronota* the species *Tephronota humilis* Loew [= *Herina ruficeps* v.d. Wlp.], which is a Nearctic species, and *Tephronota gyrans* Loew [= *Herina tristis gyrans* (Loew)], his genotype, which is a Palaearctic species, it follows that the other, closely related Nearctic species are also congeneric with the Palaearctic species. Hennig, in his recent revision of the Palaearctic species of Otitidae, established the validity of the name *Herina* Desv. in Europe, and his description of the genus applies equally well to the Nearctic species.

Key to Nearctic Species (♂ and ♀)

1. Apex of apical cell hyaline (Fig. 1a); legs yellowish 2
 Apex of apical cell infuscated (Fig. 3a); legs brownish or black 3
2. Wings with 3 fasciae (Fig. 1a); abdomen subshining, chestnut-brown, often paler basally; abdomen of ♂ mainly shining, except for a mid-dorsal pollinose stripe over tergites 1-3 *narytia* (Walk.)
 Wing with 4 fasciae (Fig. 2a); abdomen dull, grey and brownish pollinose, uniformly chocolate-brown in ground colour; ♂ with tergites 1-3 grey and brownish pollinose *ruficeps* v.d. Wlp.
3. Base of wing and basal one-third of costal cell hyaline (Fig. 3a); abdomen of ♀ lightly pollinose basally, of ♂ with a mid-dorsal pollinose stripe over tergites 1-3; legs brownish *canadensis* (Johns.)
 Base of wing and costal cell almost wholly infuscated (Fig. 4a); abdomen in both sexes shining black; legs blackish *nigribasis* n. sp.

Herina canadensis (Johnson), new combination

Figs. 3a, 3b, 3c, and 3d

Tephronota canadensis Johnson, 1902, Ent. News 13: 144; Aldrich, 1905, Cat. N. Amer. Dipt., p. 59.

Johnson neglected to describe the pollinosity of the abdomen of this species. Cinereous pollen covers the first tergite entirely, and extends as a median vitta over the second and third tergites. Though this applies in a lesser degree to the females, it is much more apparent in the males. Sometimes the posterior margins of tergites 2 and 3 of the males are narrowly bordered with similar cinereous pollen. As is characteristic of all North American species of *Herina* Desv. examined, the ninth tergite is also cinereous pollinose.

H. canadensis (Johns.) may be most easily confused with *H. nigribasis* n. sp. The characters given in the key, together with the lighter colour of the former throughout, i.e., frontal vitta and antennae, including arista, yellowish, legs brownish, makes separation fairly easy.

Distribution: The type locality for *canadensis* is Rigaud, Que., but it seems to be widespread in North America. In the Canadian National Collection there

are 23 specimens providing the following data:—NEW BRUNSWICK: Barber, June 23, 1914 (J. D. Tothill); QUEBEC: Georgeville, June 27, 1936 (G. S. Walley); Hemmingford, July 12, 1926 (G. H. Hammond); Hull, June 27, 1907 (?); Knowlton, Aug. 7, 1929 (L. J. Milne), Aug. 12, 1929 (G. S. Walley); Rigaud, June 27, ? (Beaulieu); St. John's, July 1, ? (?), ONTARIO: Go Home Bay, June 21, 30, and July 11, 1932 (G. S. Walley); Ottawa, July 7, 1904 (W. Metcalfe), July 10, 1906 (Beaulieu), June 28, 1919 (J. McDunnough); Trenton, June 19, 1904 (Evans); MANITOBA: Teulon, July 7, 1923 (A. J. Hunter); BRITISH COLUMBIA: Clinton, June 13, 1938 (J. K. Jacob); INDIANA: Hammond, June 24, 1915 (Aldrich).

***Herina narytia* (Walker), new combination**

Figs. 1a, 1b, 1c, and 1d

Trypeta narytia Walker, 1849, Ins. Br. Mus. 4: 1020; Osten Sacken, 1878, Cat. N. Amer. Dipt., p. 260 (as probable synonym of *Tephronota humilis* Loew).

For many years this species, described from material collected in Florida, was confused by various authors with *H. ruficeps* v.d. Wlp. Dr. F. van Emden, of the British Museum, very kindly compared Walker's type with specimens of the latter species and also with *H. canadensis* (Johns.). From his drawings and comments it was obvious that *narytia* is distinct. I now have before me 8 specimens from the United States National Museum that comply with van Emden's notes on the type of *narytia* Walk.; of these, 5 are from Florida.

Since Walker's description of the species is inadequate, I shall redescribe it as follows:—

Brownish species with subshining, chestnut-brown abdomen; wing three-banded, with little or no infuscation in the region of the humeral crossvein; apex of the apical cell hyaline; legs and front coxae yellow; humeri, scutellum, and often the first abdominal tergite tending to be dirty yellowish. Length excluding the ovipositor, 2.75-3.5 mm.; wing, 3.00-3.25 mm.

Male: Cheeks, face, frons, and antennae yellow; occiput, genae, parafacials, and parafrontals bearing a white bloom; the yellow of the frontal vitta extending posteriorly over the vertex and surrounding the dark-brownish ocellar triangle, frons sometimes with rufous blotches anteriorly; third antennal segment pubescent, somewhat darkened above; arista pubescent, sandy-yellow in colour.

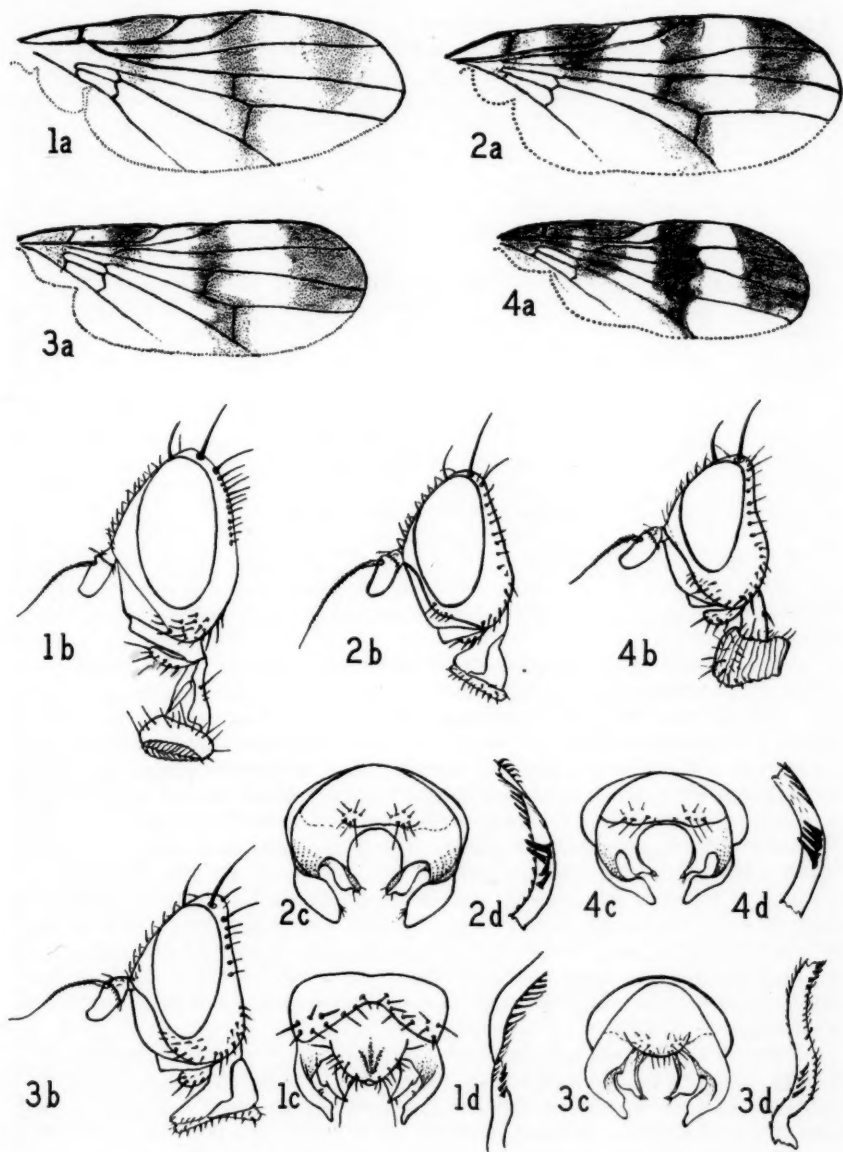
Thorax brownish, heavily covered with dull, greyish-brown pollen; mesonotum with two rather narrow, posteriorly abbreviated, darker vittae; humeri and lateral and ventral aspects of scutellum dirty yellowish in ground colour; antero-ventral margins of mesopleura and pteropleura often yellowish; chaetotaxy as outlined for the genus.

Legs yellow; tips of tarsi, femora above, and middle and hind coxae usually somewhat darkened; middle femora with 2-4 fairly strong bristles on the antero-dorsal surface.

Wings whitish-hyaline with three brownish-black fasciae as illustrated (Fig. 1a); base of wing with little or no infuscation in the region of the humeral crossvein; the main band usually continuous and straight in its general direction, often without a distinct knee-shaped bend between the third and fourth veins.

Abdomen usually chestnut-brown in colour but sometimes darker; most of the first segment, which is often lighter in colour, thinly brownish-dusted but segments 2-4 glossy except for a median vitta of thin greyish-brown dust extending over tergites 2 and 3; hind margins of 2 and 3 with linear, very inconspicuous, grey-dusted hind margins. Hairs fairly short, brown and reclinate.

Female: The female differs from the male in that the pollen of the abdomen is more or less uniformly distributed in a very thin coat; the abdominal dorsum



Figs. 1a-1d. *Herina narytia* (Walk.). 1a, wing; 1b, head; 1c, ♂ genital armature; 1d, base of aedeagus. Figs. 2a-2d. *Herina ruficeps* v.d. Wulp. 2a, wing; 2b, head; 2c, genital armature; 2d, base of aedeagus. Figs. 3a-3d. *Herina canadensis* (Johns.). 3a, wing; 3b, head; 3c, genital armature; 3d, base of aedeagus. Figs. 4a-4d. *Herina nigribasis* n. sp. 4a, wing; 4b, head; 4c, genital armature; 4d, base of aedeagus.

is therefore only slightly shining. In darker specimens there are slight indications of grey bands along the anterior margins of the tergites when viewed from certain directions. In no case is the abdomen as heavily pollinose as in *ruficeps* v.d. Wlp.

H. narytia (Walk.) is very close to *H. ruficeps* v.d. Wlp. from the standpoint of wing markings (Figs. 1a-2a), and females of the two species are sometimes difficult to separate. However, in *ruficeps* the wing tends to be 4-banded, i.e., the wing is distinctly infuscated in the region of the humeral crossvein, and the abdomen is heavily pollinose with distinct, grey, transverse bands, whereas in *narytia* the wing is 3-banded and the abdomen is subshining. The preapical hairs on the last segment of the ovipositor are somewhat longer in *narytia* than in *ruficeps*.

In the males the structure of the genital armature (Figs. 1c, 3c) seems to indicate that *narytia* is more closely related to *canadensis* (Johns.), but these two species are easily separated on wing characters (Figs. 1a, 3a). The wing of *canadensis* is similar to that of *narytia*, however, in that there is very little infuscation in the region of the humeral crossvein.

Distribution: There are specimens in the United States National Museum as follows:—FLORIDA: Mar. 2, 1918 (J. M. Aldrich) 1 ♂, 4 ♀; S. GEORGIA: (Morrison) 1 ♀; MARYLAND: Bladnsg. (F. C. Pratt) 1 ♂; NEW HAMPSHIRE: (Morrison) 1 ♀.

Herina nigribasis new species

Figs. 4a, 4b, 4c, and 4d

Blackish species; the front orange-yellow to brownish-orange, often bright red anteriorly; base of the wing, including the costal cell, heavily infuscated; abdomen without pollen dorsally. Length excluding the ovipositor 2.75-3.5 mm. Wing, 2.75-3.25 mm.

Male: Head with cinereous-white pollen over the occiput, cheeks, and orbits; parafrontals and parafacials appearing silvery-white in some lights; frontal vitta with the upper two-thirds orange-yellow to brownish-orange, this colour ending abruptly at the posterior ocelli, the lower one-third often wholly bright red, always with some reddish pigmentation; face yellowish-orange, sometimes streaked with red on the carina and the oral margin. Antennae yellowish-orange to orange, upper half of third segment brownish to brownish-black.

Thorax black, covered with cinereous pollen; mesonotum with two rather narrow, posteriorly abbreviated, darker vittae; two postsutural dorsocentral bristles, the posterior one weaker, and two outstanding mesopleurals, otherwise chaetotaxy as outlined for the genus; scutellum feebly shining, lightly coated with brownish-grey pollen; two pair of scutellars, the apical pair stronger.

Legs black; front coxae brownish; the points of articulation of the femora yellowish; tarsi yellowish in ground colour, covered with stout black hairs, the apical segments darker.

Wings whitish-hyaline with four black fasciae as illustrated (Fig. 4a); base of wing, including the humeral and the costal cells, heavily infuscated; the second fascia reaching to or slightly beyond the base of the discal cell; apical cell infuscated at its apex. Distance between the anterior and posterior crossveins varying, but always less than the length of the anterior crossvein.

Abdomen black or brownish-black, shining; without pollen dorsally in both sexes; genital armature (Fig. 4c) brownish-black, the ninth tergite cinereous pollinose. Hairs short, black, and reclinate.

Female: As in the male but without pollen on ninth tergite.

Holotype: ♂, Gillam, MANITOBA, July 28, 1950. (J. F. McAlpine); No. 5932 in the Canadian National Collection, Ottawa, Canada.

Allotype: ♀, same data.

Paratypes: 3 ♂, 9 ♀, same data; 1 ♀, same locality, Aug. 1, 1950.

All specimens were taken at the border of a swampy area from the flowers of *Potentilla fruticosa* L.

*Herina nigribasis*³ may well be the North American counterpart of *H. frondescentiae* (L.), which is found in Sweden, southern Finland, Denmark, England, Scotland, and Ireland. The literature indicates that the two species are similar from the standpoint of distribution, habitat (*frondescentiae* is found in swampy places on *Carex* and *Juncus*), pollinosity, and colour. The wings of the two species are comparable in shape and in the amount of infuscation but have distinctly different patterns.

In the Nearctic fauna *H. nigribasis* is most closely related to *H. canadensis* (Johns.), but it can be readily distinguished from the latter by the following characteristics: its heavily infuscated wing base, including the costal cell (Figs. 3a, 4a); its darker colouring throughout, particularly on the frontal vitta, antennae, including arista, and legs; and the absence of pollen on the abdominal tergites in both sexes.

Herina ruficeps v.d. Wulp

Figs. 2a, 2b, 2c, and 2d

Herina ruficeps v.d. Wulp, 1867, Tijdschr. v. Ent. 10: 156.

Tephronota humilis Loew, Loew and Osten Sacken, 1873, Monogr. Dipt. N. Amer. 3: 123-125; Osten Sacken, 1878, Cat. N. Amer. Dipt., p. 260.

Tephronota narytia Coquillett, nec Walker, 1900, J. New York Ent. Soc. 8: 22 (as synonym of *T. humilis* Loew); ? Winn and Beaulieu, nec Walker, 1915, Prelim. List Ins. Prov. of Que. 2: 152.

Tephronota ruficeps (v.d. Wulp.), Johnson, 1902, Ent. News 13: 143-144; Aldrich, 1905, Cat. N. Amer. Dipt., p. 591.

Johnson established the validity of v.d. Wulp's name, *ruficeps*. Loew evidently suggested *humilis* Loew to avoid confusion with *Ortalis ruficeps* (Fab.) [= *Scatophaga ruficeps* Fab., 1805], this notwithstanding the fact that in the same paper⁴ in which he placed *ruficeps* v.d. Wulp. in his genus *Tephronota* he also named *ruficeps* (Fab.) a "typical species" of the genus *Ortalis* Fall. Older workers have been known to rename similarly named species in closely related genera, but according to modern usage the name *ruficeps* v.d. Wulp. is valid on all counts. Osten Sacken is also in agreement on this point.

Distribution: There are 34 specimens in the Canadian National Collection providing the following data:—NOVA SCOTIA: Digby, July 6, 1935; mountains above Bay Pleasant, July 24, 1941; Smith's Cove, July 24, 1945 (J. McDunnough); QUEBEC: Hemmingford, July 5, 1925 (G. H. Hammond), Aug. 6, 1929 (G. S. Walley); Hull, June 27, 1903 (?), July 18, 1914 (Beaulieu); Kingsmere, July 21, 1914 (C. G. Hewitt); Knowlton, July 22, 1929 (L. J. Milne), Aug. 6, 1929 (G. S. Walley); Rigaud, June 25, 27, 1906 (Beaulieu); ONTARIO: Centreville, June 27, 1925 (G. S. Walley); Ottawa, July, 1914 (G. Beaulieu), July 18, 19, 1946 (A. R. Brooks), July 17, 1904 (H. Metcalfe); Putnam, June 26, 1925 (G. S. Walley); Simcoe, June 24, 30, 1939 (G. E. Shewell); Southampton, Aug. 8, 1945 (G. S. Walley); Trenton, June 12, 1904, June 26, 1911, July 7, 20, 1911 (Evans). Six specimens from the United States National Museum provide the following additional data:—INDIANA: La Fayette, Aug. 19, 1916 (J. M. Aldrich); MICHIGAN: Boyne City, June 24, 1930 (G. Tolles); Emmet Co., Aug. 14, 1943 (R. R. Dreisbach); Livingstone Co., July 25, 1943 (R. R. Dreisbach); NEW HAMPSHIRE: Hanover (C. M. Weed); PENNSYLVANIA: Fern Rock, June 20, 1903 (?).

³Re distribution: 7 specimens of this species collected at Canyon Creek, B.C., July 11, 1950, by the Forest Insect Survey, were recently received by the writer. This series was swept from *Pinus contorta* Dougl.

⁴Loew and Osten Sacken, 1873, Monogr. Dipt. N. Amer. 3: 55, 123.

Genitalic Characters

Males of the Nearctic *Herina* Desv. possess fairly striking and constant genitalic characteristics (Figs. 1-4, parts c and d). The ninth tergite bears on its lower posterior angles a pair of long, backwardly directed, incurving lobes (*surstyli* of Crampton⁵), which are somewhat flexible at their bases. The bulging, membranous tenth segment (*proctiger* of Crampton), in which the anus appears as a more or less horizontal slit, also bears a pair of incurving lobes (*cerci* of Crampton), which are closely associated with those of the ninth segment. These sclerotized structures are sometimes referred to as *outer* and *inner* genital forceps or claspers, respectively. The size and shape of both pairs differ in the four species as shown in the figures. The drawings were made from posterior views that just permitted a view of the cerci above the surstyli.

The bases of the long, curled penes differ somewhat in the form and size of a row of spines on the left side of their dorso-lateral surfaces. Only a limited number of specimens were examined, and I do not know how reliable these particular characters may be. Attention is drawn to them here merely as a suggestion for other workers.

Acknowledgments

I am very grateful to Dr. F. van Emden of the British Museum, London, England, for his co-operation in establishing the identity of *H. narytia* (Walk.); to Dr. Willis W. Wirth of the United States National Museum, Washington, D.C., for loaning specimens for study; and to Mr. G. E. Shewell, Division of Entomology, Ottawa, for advice and aid.

⁵Crampton, G. C., 1942, Dipt. of Connecticut, Fasc. 1: 76-87.

On the True Identity of *Geophilus huronicus* Meinert and the Presence of *Geophilus longicornis* Leach in North America (Chilopoda: Geophilomorpha: Geophilidae)

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In 1886¹ Meinert described a new centipede from New England which he called *Geophilus huronicus*. This centipede, characterized at some length and with considerable accuracy in the original description, is peculiar in that it is rather unlike any other known North American member of the genus.² Perhaps for that reason, as well as because he had never seen *huronicus*, Attems³ placed it in his long roster of questionable New World species.

Upon examining the types at the Museum of Comparative Zoology at Harvard recently, I found *huronicus* to be based upon four specimens of two well-known but previously described species. Two specimens in a vial marked "Massachusetts" are *Arenophilus bipuncticeps* (Wood); the other two typical specimens in a second vial once labelled "New England" are *Geophilus longicornis* Leach, a Geophilid previously unrecorded from this continent (to my knowledge) but widely distributed throughout Europe. Meinert's description is based mainly upon the latter two specimens, although all four were plainly indicated as being new species.

¹Meinert: *Proc. Amer. Philos. Soc.*, XXIII, p. 220, (1886).

²Bollman, (*Proc. U.S. Nat. Mus.*, XI, p. 347, (1888)), pointed out that his new species, *Geophilus smithii*, was much like Meinert's *huronicus*. Unfortunately it is impossible to determine exactly what Bollman based his new name upon; the original description certainly leaves much to the imagination, and the types at the U.S. National Museum cannot be located at the present time. It is possible that he based *smithii* upon *Geophilus mordax* Meinert.

³Attems: *Das Tierreich*, lief. 52 (1929).

The New England specimens of *longicornis* were seen to be identical with German members of the species by direct comparison.

It is very probable that *longicornis* was imported into North America along with agricultural produce. Its rarity in one or two localities would suggest this. Also it is suspected to have been imported into other areas too, for Palmén⁴ reports it commonly in Finnish greenhouses and their environs, suggesting that the Finnish forms, being identical with the more southern European *forma typica*, were introduced by man.

In 1950⁵ I reported the presence of *Pachymerium tristanicum* Attems in Smiths Falls, Ontario, but it is clear now that the Smiths Falls specimen is conspecific with *Geophilus longicornis* Leach.

It is noteworthy too that Attems' description of *Pachymerium tristanicum*⁶ seems to characterize Leach's *longicornis*, a species which in many respects appears to occupy a morphologically more or less intermediate position between *Pachymerinae* and *Geophilinae*. The fact that Attems reports *tristanicum* from south-western Europe as well as from the south Atlantic island of Tristan d'Acunha makes it plausible to suspect that this species too is based upon an imported specimen of the itinerant *Geophilus longicornis*.

⁴Palmén: *Annales Zoologicae Societatis Zoologicae Fennicae* Tom. 13, no. 4, p. 13, (1949).

⁵Crabill, *Canad. Ent.*, LXXXII, p. 101, (1950).

⁶Attems: *Ann. S. African Mus.*, XXVI, p. 157, (1928).

Supplementary Notes on the Canadian Species of Cixiidae (Homoptera: Fulgoroidea)¹

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The Canadian species of Cixiidae were discussed in a recent paper (Beirne, 1950). In the present paper a species new to the Canadian fauna is recorded, and changes in the specific names of two other species are proposed.

Oliarus aridus Ball

Oliarus aridus Ball, 1902, *Can. Ent.* 34: 151.

Oliarus breviceps Fowler, 1904, *Biol. Centr. Amer.* 1: 94.

Specimens of this species have been captured on sour cherry at Virgil, St. Catharines, Stamford, and St. Davids, Ontario, by J. H. H. Phillips, Division of Entomology, Vineland. In the key to the Canadian species of *Oliarus* (Beirne, loc. cit.), it runs to *placitus*, but differs from that species in characters of the male genitalia, in having the frons broader and dark blackish-brown rather than brown. There is a pale-yellow, rounded spot at each side of the frons next the base of the clypeus. These spots are more rounded and distinct than the similar pale markings of *placitus*. The male genitalia of *aridus* are figured by Osborn (1938).

Cixius nervosus (Linn.)

Cicada nervosa Linne, 1758, *Syst. Nat.* 10: 437.

Cicada hemerbioides Schrank, 1776, *Beyträge Zur Nat.*: 74.

Cixius basalis Van Duzee, 1907, *Proc. Acad. Nat. Sci. Philadelphia* 1907: 489.

This common and widely distributed holarctic species is known as *nervosus* in the Palearctic region but has been referred to as *basalis* in the North American

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literature. I have examined British specimens of *nervosus*, kindly sent by Dr. W. E. China, Department of Entomology, British Museum (Natural History), and can find no significant differences between them and specimens of *basalis*. The male genitalia of *nervosus*, figured by China (1942) and Wagner (1939), is the same as that of *basalis*. *Cixius nervosus*, therefore, is the correct name for the species commonly known as *basalis*.

***Cixius quebecensis* n. n.**

Cixius fulvus Beirne, 1950, Can. Ent. 82: 100 (Name preoccupied).

Professor Z. P. Metcalf, University of North Carolina, has pointed out (in litt.) that the name *fulvus* is preoccupied by that of a Brazilian species of *Oliarus* described by Walker (1858) as *Cixius fulvus*. The name *quebecensis* is proposed for the species found in eastern Canada.

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